AMERICAN ENGINEER
CAR BUILDER AND RAILROAD JOURNAL.

MARCH, 1896.

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The Lehigh Valley Railroad is in the market for 2,000 freight cars.

The Delaware, Lackawanna & Western will soon place orders for 1,000 freight cars.

The Central Vermont Railroad Company is having 13 passenger coaches built by Jackson & Sharp.

The Adirondack & St. Lawrence has ordered 10 locomotives from the Schenectady Locomotive Works.

It is stated that the Missouri, Kansas & Texas has decided to build new repair shops at Sedalia, Mo.

The Lake Superior and Ishpeming Railway has ordered 10 locomotives from the Pittsburg Locomotive Works.

An order for 400 ore cars for the Lake Superior & Ishpeming road, has been placed with Wells & French.

The Elliott Car Works, Gadsden, Ala., are building 150 freight cars for the Chattanooga, Rome & Columbus.

The Ohio River Railroad has ordered 300 cars from the Ensign Manufacturing Company, Huntington, W. Va.

The Chicago & North Western has ordered 100 furniture cars from the Haskell & Barker Car Co., Michigan City, Ind.

The Erie has ordered 1,700 cars from the Michigan-Peninsular Car Company and 500 from the Buffalo Car Company.

The Paris Gas Company is putting a Luhrig gas tram car on the Paris Omnibus Company's tramway lines by way of experiment.

The Pennsylvania Railroad Company has ordered the construction of 500 new gondola hopper coal cars at the Altoona shops.

The Wheeling & Lake Erie Railroad has ordered 1,000 freight cars from the Barney & Smith Car Company, Dayton, Ohio.

The Baldwin Locomotive Works has received an order, from the Cincinnati, Jackson & Mackinaw Railroad for five locomotives.

The Great Northern Railway Company is equipping its freight cars with the New York Air Brake Company's latest form of quick action air brake.

Rumors indicate that in the near future the Cincinnatil Jackson & Mackinaw road will give orders for a considerable number of locomotives.

The locomotives under construction in the works of the Grant Locomotive Works at the time of their failure have been completed by Siemens & Halske and are now for sale.

The South Baltimore Car Works has contracted to build 400 freight cars for the West Virginia & Pittsburgh Railroad Company, and 300 coal cars for several coal companies.

The Baldwin Locomotive Works has a contract for 32 additional locomotives to go to Russia. These engines will be 10-wheeled compound passenger engines and will burn naphtha.

The practice of taking the control of heating apparatus on sleeping cars from the porters and putting it in control of the train crew, is extending. Orders were recently issued on some divisions of the Pennsylvania transferring these duties to the trainmen.

The Lehigh Valley Railroad has ordered five heavy locomotives from the Baldwin Locomotive Works. The engines will have 22-inch by 28-inch cylinders, and are intended for service on heavy grades.

The boiler of a locomotive drawing the New York and Philadelphia express train on the Delaware, Lackawanna & Western Railroad exploded near Cassville, N. Y., Feb. 18, killing both the engineer and fireman.

The Brooks Locomotive Works has an order from the Northern Ohio for building six Mogul engines with 18-inch by 24-inch cylinders. These engines are duplicates of those for the Lake Erie & Western, which operates the Northern Ohio.

The Barney & Smith Manufacturing Company, of Dayton, O., will built for C. J. Hamlin, of Buffalo, a private car for the transportation of racehorses. It will be 62 feet long, and will be carried on six-wheeled trucks with steel-tired wheels.

The Chicago & Northwestern Railway is now equipping its freight cars with Westinghouse air brakes at the rate of 25 cars per day. The foundation brakes are at the same time thoroughly overhauled and made to conform to M. C. B. standards.

The New York Central has given an order for 2,150 freight cars, of which the Buffalo Car Company received 1,250, the Union Car Works 500, and the Barney & Smith Company 400. The first two allotments are coal cars, and the last platform cars.

The New York, Chicago & St. Louis has put into service the 10 new freight engines recently received from the Brooks Locomotive Works and the Schenectady Works, and are much pleased with them. They will soon receive three switchers from the same builders.

The 10 mogul locomotives ordered by the Illinois Central from the Brooks Locomotive Works will have 19-inch by 26-inch cylinders, Belpaire boilers 62 inches in diameter, driving wheels 56 inches in diameter and long fireboxes. The total weight of the engine will be about 125,000 pounds.

A policy of rigid economy has been decided upon by the new Atchison management in order to make a saving of at least $1,000,000 a year. President Ripley is making a tour of inspection of that system with the sole purpose of noting the different points where the reductions can best be made. —*San Francisco Bulletin.*

Indian Engineering is authority for the statement that a German has been granted a 75 years' concession for the construction of a carriage road from Teheran to Bagdad. He has also obtained a 90 years' concession for a steam or electric tramway, 10 miles in length, from Teheran to the villages north of the city.

The Monterey & Mineral Belt Railway, of which ex-General Manager Robinson, of the Monterey & Mexican Gulf road, is one of the owners, is to be extended to Matehuala, a rich mining section south of Monterey. The road is now in operation a distance of 20 miles, and is doing a heavy ore business.—*San Francisco Bulletin.*

The new hospital for employees of the Atchison, Topeka & Santa Fe Railroad at Topeka has been opened. It is a large and handsome building, four stories high, and cost about $125,000. The Santa Fe Hospital Association, supported by assessments upon the employees, was chartered in 1891. This association controls this hospital and also those at La Junta and Las Vegas.

The Westinghouse Electric & Manufacturing Company, is equipping the Turtle Creek Valley branch of the Pennsylvania Railroad with an overhead trolley wire to test Westinghouse-Baldwin electric locomotive. This branch runs from Brinton to Murraysville, Pa., and is about 11 miles long. The new locomotive is now at the Westinghouse Electric Company's Works.

The entire Pennsylvania system has adopted the practice of covering the handrails, cylinder-head casings, steamchest casings and other parts of locomotives with paint, instead of giving them a bright finish as has been the custom from time immemorial. The enginemen, it is said, are also required, much to their disgust, to take off the deer horns, stars and other unofficial ornaments that have decorated their engines in the past.

The Pennsylvania Railroad has issued orders for the construction of 38 new locomotives in the Altoona and Juniata shops. Six class "U" switch engines and 12 class "M' switching engines will be built at the Altoona shops, and eight class "L" heavy fast passenger engines and 12 new compound moguls will be built at the Juniata shops. A portion of the switching engines and moguls are intended for lines west of Pittsburg, and five of the new class "L" engines are for the Panhandle.

The *Cosmopolitan Magazine* offers $3,000 in premiums which will be awarded to motor carriages exhibiting the greatest excellence in a trip to be made on Decoration Day, May 30, between City Hall Park and the Cosmopolitan Building at Irvington-on-Hudson. The round trip is about 52 miles. The following points will be considered in making the award: Speed, 50 points; simplicity and durability of construction, 25; ease in operating and safety, 15; cost, 10. Entries must be made before May.

The first official exhibition of the electric motors used to switch the cars on the Brooklyn Bridge was made February 8, in the presence of President Howell, Vice-President J. S. Page and Trustees Keeney and Henriques. The motor car was coupled to three of the ordinary passenger cars, making a train of four cars which was switched by the motors from the incoming to the outgoing tracks and up to the cable sheaves several times. The car made two round trips over the bridge to the satisfaction of the officials present.

At a meeting of the shareholders of the Mount Yamalpais Scenic Railway Company, held early in February, Sidney B. Cushing was elected President; David McKay, Vice-President; Louis L. Janes, Secretary, and the First National Bank of San Francisco, Treasurer. A contract for grading and track laying was let to the California Construction Company and work has already begun. Contracts are about to be let for engines, boilers, dynamos and other requisites for generating power. Work on the power house will be commenced at once.

Some new machinery is being installed in the shops of the car department of the Lake Shore road. At Cleveland a new 105 horse power Buckeye engine having a cylinder, 14½ by 26 inches, will be put in, and also a No. 2 Fay dimension planer which can dress simultaneously four sides of a timber 20 by 26 inches and reduce the size 2 inches at one passage through the machine. At the Adrian shops a No. 2 Putnam wheel borer will be installed, and at the Englewood shops a No. 7 Greenlee hollow chiselmorticer, with straight and angle boring attachments.

The Lake Shore & Michigan Southern Railway placed car orders last month as follows: With the Michigan-Peninsular Car Company, 500 drop bottom coal cars of 60,000 pounds capacity and 500 standard box cars of 60,000 pounds capacity; with the Madison Car Company, 250 coal cars and 250 box cars; with the Wells & French Company, 250 box cars; with the Union Car Company, 250 coal and 100 box cars, which are to be lettered for the Pittsburgh & Lake Erie and to be delivered prior to May 1. All the other coal cars are also to be delivered prior to May 1, but the box cars are to be delivered during August and September.

Representatives of the Carnegie Steel Company and Bethlehem Iron Company appeared before the Senate Committee on naval affairs last month to protest against the enactment of Senator Smith's bill providing for the erection of a government armor-plate plant in Washington. These companies asserted that to equip such a plant would cost more than $4,000,000, and they argued that in view of the fact that immense sums had been invested by private persons in this business at the suggestion of the Government, it would be unjust for the Government to render that outlay useless by the construction of competing works that could do the work no better and no cheaper.

The annual report to the stockholders of the Chicago & Alton Railroad, issued last month, shows the net earnings for 1895 to be $2,819,493, an increase of $155,944 compared with 1894. President Blackstone, in the report, takes occasion to declaim against what he terms popular control of railroads. He sets forth that the Supreme Court of the United States long ago held that the charter of a railroad corporation is a contract within the meaning of the contract clause of the constitution, but that the people have failed to remember their side of the contract. One of the provisions of such contracts is that railroads shall always have power to collect reasonable rates, but the state has passed a law enabling a state board to limit railway rates at their discretion.

It is reported that successful arrangements for preventing damage to merchandise through excessive cold have been experimented with on a German railroad. The winter 1894-5, which was particularly severe throughout Central Europe, caused great losses of perishable freight in transit during the winter months. It was, therefore, proposed to heat freight cars carrying such goods. A stove in the center part of the car, which is fed from without, supplies the necessary warmth, and a thermometer, which is visible from the outside, reveals to the inspector, whose duty it is to ascertain the temperature of each car at every station, whether he has to open the ventilators on top to reduce the heat or whether new fuel ought to be introduced to keep up the fire and increase the temperature. A slight additional freight is charged, and as the shippers prefer this increase to the uncertainty of the weather, the entire system is said to have been pronounced a success on all sides.

Bradstreet's, in reviewing the gross earnings of railways in January, 1896, had the following to say regarding the large increase: "January gross earnings may be classed as very satisfactory, showing as they do a continuance and accentuation of previous favorable conditions and the practical disappearance of many unfavorable features which have marked gross earnings reports for the past few months. The total earnings of 126 railroads for January aggregate $37,761,005, an increase over January a year ago of 11.3 per cent., this large gain being made on a total of 92,766 miles, an amount which may be regarded as truly representative of the country's operated railroads. Not only is the gain shown in January in excess of that recorded for some time past, but the number of large increases is larger and decreases are smaller in number and in volume than for many months past. In fact, the month just closed makes a very welcome showing as regards the small number of decreases and the trifling volume of the declines shown from January a year ago."

Communications.

The Westinghouse Air-Brake Company versus The Boyden Brake Company.

Editor American Engineer, Car Builder and Railroad Journal:

The issue by the Boyden Brake Company of a circular dated December 31, 1895, in which that company asserts, among other misleading statements, that the decision of the Fourth Circuit Court of Appeals in favor of that company is *final*, makes it necessary for us to state that the United States Supreme Court has, upon petition of our counsel, based upon a few of the serious errors involved in that decision, granted a writ of certiorari directing the case to be sent up to it for revision and final judgment.

The Boyden Company's statement was manifestly prepared before the Supreme Court granted the writ of certiorari, and it will thus be seen that that company is not yet finally authorized to make and sell quick-action air-brake, without liability for infringement of our patent rights.

We have never doubted that the final decision in this case will reaffirm the validity of our pioneer quick-action air-brake patent (No. 360,070, the one in dispute,) as already established in other courts; for Judge Hughes, in his decision in favor of the Boyden Brake Company, says:

"That this invention of Westinghouse, thus undefined (the Court then referring to the second claim), is one of the highest value to the public, and that it is a pioneer one in the art of quick action brakes is not denied, and is conceded. It is conspicuously one of those pioneer inventions which entitle the proprietor to a liberal protection from the courts in construing the claim."

A statement in accord with the opinions of the other courts which have, in each instance, conceded and affirmed the pioneership and value of this invention.

In each of the three previous decisions in favor of this patent, the second claim has been upheld and has not, in any manner, been held to be insufficient, even in any technical sense, to fully cover the invention; and we therefore the more strongly feel that our confidence in the ultimate determination of this litigation in our favor is well founded.

The Boyden Brake Company has issued an illustration and description of a new form of quick action triple valve, which it states was subjected to a satisfactory rack test at Altoona, by the air-brake committee of the Master Car Builders' Association. This new valve has not hitherto been the subject of litigation under our patents and has never, to our knowledge, been commercially used or tested. We believe that the construction of this valve comes clearly within the claims of one of our patents, and we have promptly brought suit against the Boyden Company, to restrain that company from making and selling this new valve.

It will not be out of place to call attention to the fact that railway companies have, in numerous instances, been misled by the statements of various parties manufacturing brakes, in infringement of our rights, and the loss inflicted upon those who have purchased brake apparatus in reliance upon those statements has already been very great. We feel convinced that we are fully justified in believing that our patents fully cover all of the forms of quick-action brakes which have so far been offered for sale, and that the courts will finally so decide.

The Westinghouse Air Brake Company,
H. H. Westinghouse, General Manager.

Pittsburgh, Pa., Feb. 1, 1896.

Laird Crossheads.

Editor American Engineer, Car Builder and Railroad Journal:

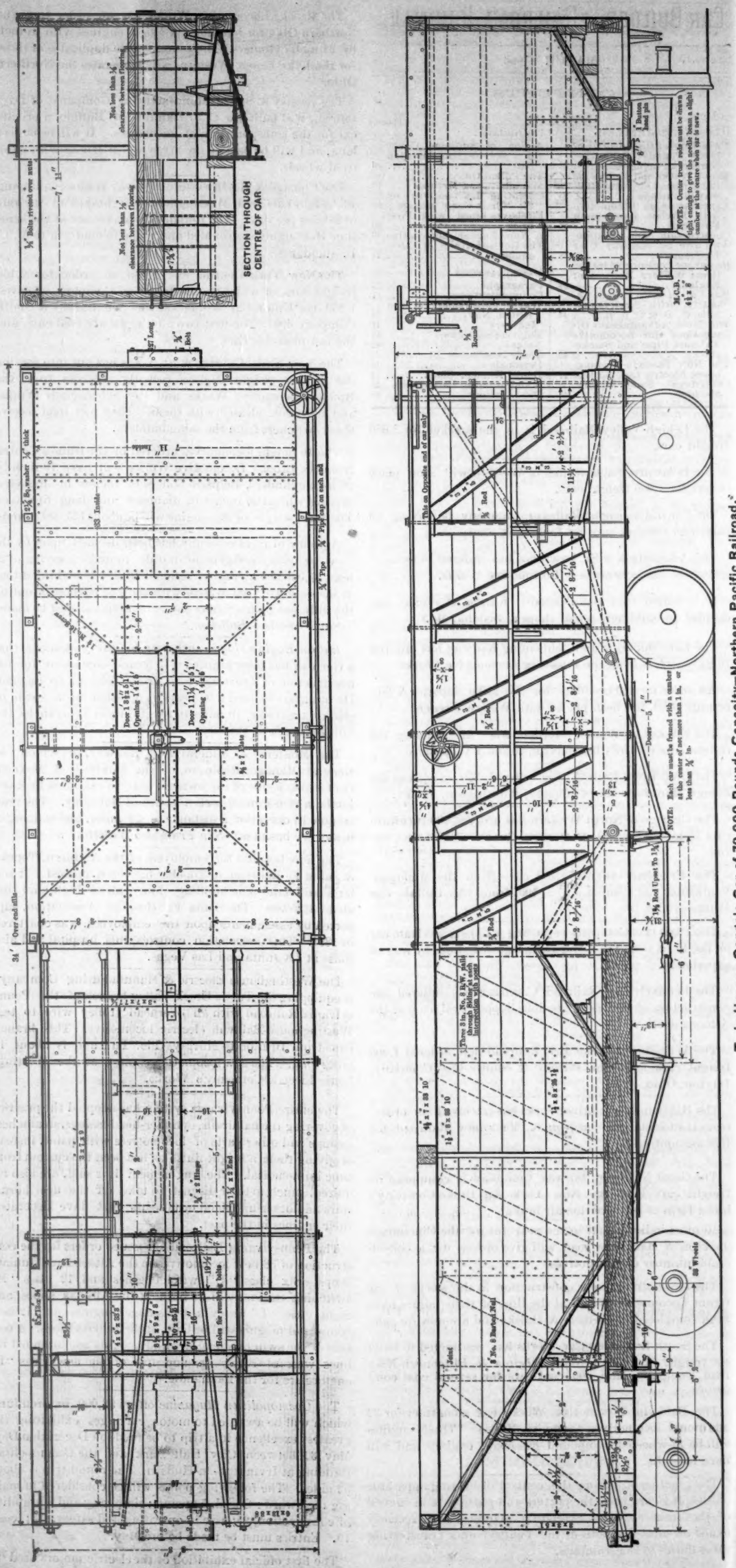
I saw recently a rather ponderous explanation in some railroad paper as to why piston rods of Laird crossheads break so often. The explanation was that it was due to the center of gravity of the crosshead being so far above the piston-rod, thus forming in action an overhanging and unbalanced weight that tends to bend the piston rod. The real cause is that the thrust of the piston acting on the short lever of the crosshead tends to rock it and force apart the guides. The wear is more rapid than with the four-bar guide because of this tendency to rock the crosshead, and therefore it is simply a question of increasing the wearing surface. Why are such self-evident facts neglected by a technical paper?

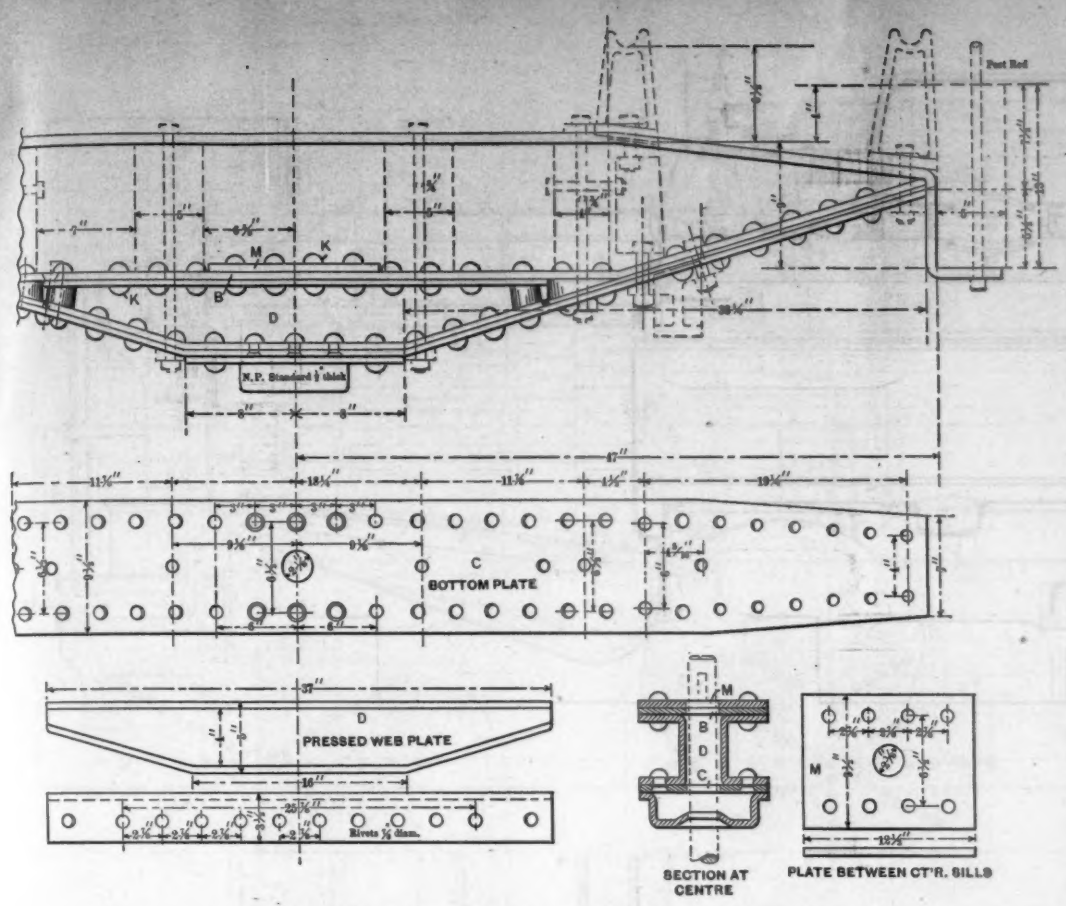
It is clear to any one who will examine the matter that the whole trouble is due to a want of wearing surface on the crosshead to resist the action mentioned. This constant effort to separate the guides wears the crosshead wings rapidly and the unbalanced overhang of the crosshead alone would not bend the rod in a hundred years. Laird guides are often convenient if not necessary in certain cases, and should be designed with the distance between guides and piston rod as short as possible and with an increase of guide surface.

The erroneous explanation of the technical paper mentioned has, I find, been accepted by some master mechanics, who by lightening the crosshead have attempted to correct a fault which does not exist, and in more than one case ended in broken crossheads and wrecked cylinders.

G. A. Harwood.

[Our correspondent is apparently quite sure of his position, but he has fallen into the error of greatly underrating other people's thinking apparatus. Many close students and practical men whose opinions are respected have at various times in the last five years charged the frequent breakages of piston rods attached to Laird crossheads to the inertia of the unsymmetrical weight of the latter. Their arguments have been presented so many times that there is no occasion for us to repeat them now. The argument of our correspondent lacks clearness and force and is hardly strong enough to support his position.—Ed.]





Body Bolster for Gondola Car of 70,000 Pounds Capacity.

Twin-Hopper Gondola Car of 70,000 Pounds' Capacity—Northern Pacific Railroad.

Several roads have built coal, ore, or other special cars to carry 70,000 pounds, but we believe that the Northern Pacific Railroad is the first to get out drawings for standard box, flat, and gondola cars of this capacity. Their box car is 41 feet long inside, 42 feet long outside of the end sills, 9 feet 1 inch wide over the sills, 8 feet 6 inches wide inside, and 7 feet 10 inches high in the clear. The flat car is 41 feet long, and the gondola car 34 ft. long. This last-mentioned car we illustrate through the courtesy of Mr. John Hickey, Superintendent of Motive Power.

As will be seen from our illustrations, the car has twin-hoppers, the slopes of which are such as to leave no level floor space, consequently the car can be emptied without any shoveling whatever. The sills of the car are five in number, one center sill 6 inches by 10 inches, two intermediate 4 inches by 9 inches and two side sills 5 inches by 13 inches. The center sill falls short of the end sills, extending barely through the body bolsters. From the bolsters to each end sill its place is taken by two timbers, 5 inches by 9 inches, to which the draft gear is attached. The drawbar is thus in the same horizontal plane as the sills.

The side framing is strong and evidently able to carry a large part of the entire load. The plate at the top of the sides is 4½ inches by 7 inches and the posts and braces are heavy. The bottom side plank is 3 inches by 10 inches and the others 1½ inches by 8 inches. The sides are 5 feet 5 inches high above the tops of the sills and 6 feet 6 inches high from the bottom of the latter. In addition to this framing there are two truss rods of deep camber 1¼ inches in diameter with ends upset to 1¼ inches. The needle beams are 6-inch channels weighing 12 pounds per foot.

The framing around the hoppers is clearly shown on our engravings. The hopper door openings are 5 feet long and 1 foot 4 inches wide on each side of the center sill. The doors are of unequal width so as to bring their edges to one side of the sill. They are raised into place by chains that wind up on to a shaft under a timber extending across the car and secured to the tops of the sides. The hand wheel at the side of the car is for operating this shaft. The doors are locked in position by a rod suspended from the cross-timber just mentioned and having a large T-shaped head at the lower end. This head is inserted in a slot between the doors and the rod given a quarter-turn, after which it is held from further turning by a latch that drops over its upper end which has a square on it for that purpose. The construction is shown in the plan and elevation of the car.

The bolster is of metal and very strong. The same design is employed for all of the three classes of 70,000-pound cars mentioned in the early part of this article. It consists of a top plate 7 inches by ¼ inch in section, and two plates in compression, each of which is 9½ inches by ½ inch in section at the center, but beginning outside of the intermediate sills are gradually narrowed to 7 inches at the ends. Between the ends of these plates there are filling pieces ½ inch thick, three inches wide and 34½ inches long, and at the middle they are separated by two pressed steel pieces of channel section 5 inches deep and 37 inches long. This makes a very substantial bolster, and one that if carefully fitted at the ends should be very stiff.

The center plates are pressed steel, and the Fox pressed steel truck is used under all of these cars. The body of this car weighs about 18,000 pounds, and the trucks about 12,000 pounds, making the total weight 30,000 pounds.

Motor Trucks and Motors for the Lake Street Elevated Railway, Chicago.

The Lake Street Elevated Railroad, in Chicago, is at present preparing its tracks for the change from steam to electric traction, and has ordered a total of 60 motor trucks from three different manufacturers. The McGuire Manufacturing Company, of Chicago, will furnish 50 of these; the Baldwin Locomotive Works eight, and the J. G. Brill Company, of Philadelphia, two trucks. The motors are to be furnished by the General Electric Company, and of the class known as "G. E. 2,000."

The cars under which the trucks will be put, are of the usual size for elevated railway traffic, being about 39 feet long over the bodies, and 46 feet long over the platforms. When fully loaded the weight above the trucks will be about 38,000 pounds, and each motor weighs about 4,200 pounds. The weight of the trucks varies somewhat with the different designs.

We present to our readers engravings made from photographs of the trucks built by the McGuire and Brill companies. The McGuire truck shown in Fig. 1 is a substantial looking piece of mechanism. It is provided with double equalizing bars cushioned at the boxes to which are secured two crossbars or transoms.

The motors are supported at the axles and also by attachments to these transoms. The springs over the journal boxes have only one inch motion after receiving their normal load. The parts mentioned maintain a constant relation to each other and are independent of the spring arrangement for the car body.

The arrangement of parts supporting the car body is peculiar. The side frames, which are of malleable iron, contain pedestals for the journal boxes in which the latter are so fitted as to permit 1½ inch lateral motion each way. Each frame rests on coil springs on the equalizers and has a large bracket or shelf on the inner side to receive the end of the truck bolster. Under this shelf is a double elliptic spring supported by a spring plank suspended from the transoms by swing links. The two side frames and bolster may therefore be considered a unit resting on four coil and two double elliptic springs and having a swing motion of 1½ inches each side of its normal position. The great advantage of this arrangement lies in the fact that the load is hauled by the truck through the medium of side frames and bolster which are rigidly connected together.

The brakes are located inside the wheels, making a short, compact truck, occupying the least possible space under the car and making the truck frame less liable to damage in case of accident. There is no brakebeam, the brakes on one side being independent of those on the other side of the truck, but having the pull rods leading from the upper ends of the levers perfectly equalized. The brakes are suspended from the truck frame by patent elastic brake hangers, which form brake heads, brake hangers and adjustable release springs all in one, and at the same time take up their own lost motion, preventing all chattering and kicking of the brakes which is so common a fault of swinging brake hangers.

These trucks are quite similar to those furnished by the same company for the motor cars that are being tried on the Brooklyn Bridge.

The truck of the Brill Company is shown in Fig. 2. The side frame is cast in one piece, and the oil-boxes have extensions cast on their under sides, into which the ends of the equalizer bars are inserted. These equalizers are perfectly straight bars, and are partly hidden in our illustra-

Fig. 1.—Motor Truck Built by McGuire Manufacturing Company for Lake Street Elevated Railway.

Fig. 2.—Motor Truck Built by J. G. Brill Company for Lake Street Elevated Railway.

Twin-Hopper Gondola Car of 70,000 Pounds Capacity—Northern Pacific Railroad.

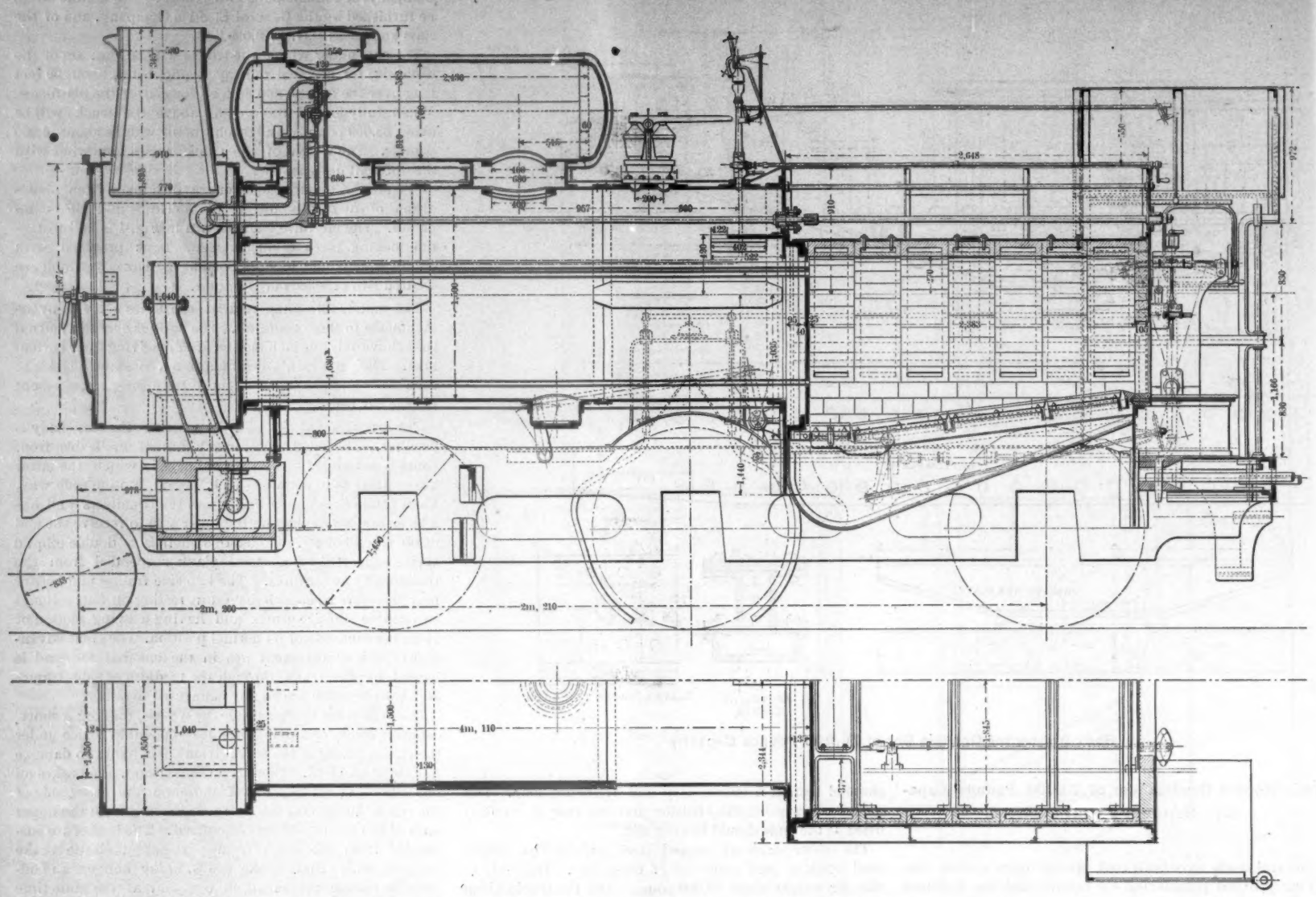


Fig. 1.—Locomotive with Firebox Lined with Firebrick.—Doctem System.

tion by the bottom bar of the side frame. The coil-springs rest on them, and, by the special construction employed, are placed nearer the journal boxes than is possible ordinarily, and thus prevent much of the tilting of trucks from the application of the brakes. The usual transoms, spring planks, elliptic springs and swing bolster complete the truck. The brakes are outside hung. The construction is exceedingly simple.

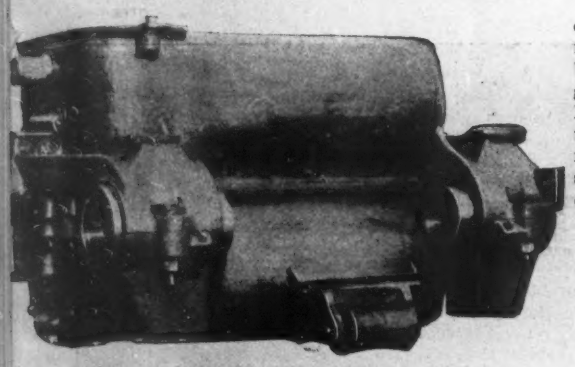


Fig. 3.—Motor "G. E. 2000" for Lake Street Elevated Railway.

The wheels for all of these trucks are 33 inches in diameter outside of the tires, with cast-iron spoke centers and Krupp tires secured by retaining rings. They weigh about 800 pounds each. The axles have 4½ by 8-inch collarless journals. The wheel base is 5 feet 6 inches.

The motors, which we have already stated are known as "G. E. 2,000," occupy a space 53 inches wide, 33 inches high and 25 inches from the axle to the end of the motor. There are two of them on each truck, and they are geared so as to develop a speed of 40 miles per hour.

A general view of one of them is given in Fig. 3. It is designed for a drawbar pull of 2,000 pounds when mounted on 33-inch wheels. For its power, its weight is comparatively light. The armature is of the "barrel" type, a method of construction which allows of the ready repair of a damaged conductor. The iron-clad construction of the armature, so conspicuously successful in other motors by the company, is followed in the G. E. 2,000.

The design and installation of the electrical equipment of this road is in charge of General Superintendent Hedley and Chief Engineer C. V. Weston.

Harper's Weekly of February 29 contained an interesting and fully illustrated article on "How Long and Lofty Bridges are Built." Some of the great engineering triumphs in this direction were described.

Note Upon Fireboxes With Firebrick Walls.*

DOCTEUR SYSTEM.

It does not seem to me to be out of place to briefly review the history of the construction of locomotive boilers, intended to accomplish the object which I have had in view for a number of years, when I proposed to the management of the State Railways of Belgium to make a test of a firebrick furnace and of building a trial boiler on my system.

The first locomotives hauling passenger and freight trains on the Manchester & Liverpool line (1826 to 1828) had iron fireboxes, and were fired with coke. These fireboxes were built of the materials procurable at the time, that is of high-grade materials, of whose actual quality we have no idea. Nevertheless, the shop superintendent of the line met so many difficulties in the maintenance of the engines and the running was so irregular that he proposed to Stephenson to substitute red copper for iron in the fireboxes, the sheets of copper being likely to last indefinitely, and then, after they had been removed from service, still having considerable value.

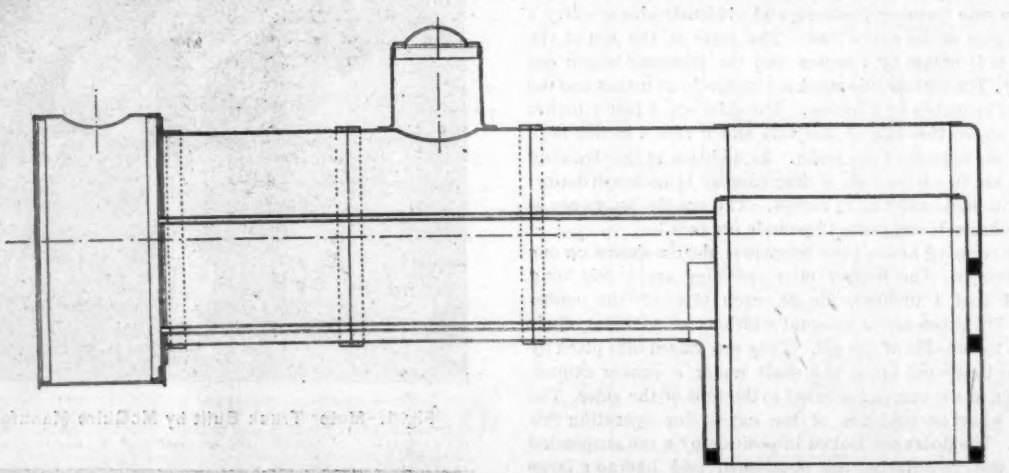


Fig. 2.—Original Boiler in Experimental Locomotive.

So the iron fireboxes were replaced by those of copper, and it is only under exceptional conditions that we have reverted to the former.

The red copper tubes that were in use at the same time were abandoned and brass substituted in their place, because the copper was so rapidly scored by the coke. As a general thing, the life of the copper tubes ranged from six to eight months, while those of brass could be kept in service from two to three years.

Afterward charcoal and homogeneous iron tubes were used where the feed water was comparatively pure; that is to say, from 18 to 20 degrees Beaumé. With coal the use of copper tubes has been resumed, and tubes of this kind are now being tested on the State Railway of Belgium, and they appear to be giving satisfactory results.

Likewise smokebox tube-sheets of copper are behaving very well in service.

But the high price of these materials adds very considerably to the cost of the boilers, and this, together with the value of the sheets held in stock for repairs, locks up a good deal of capital.

It was in order to avoid this increased expense that I have attempted to design a locomotive boiler at the lowest possible cost, while still retaining the copper tube-sheet in the firebox which the use of our ordinary fuels imposes upon us, and of forming the sidewalls and back of the firebox of refractory material which has been shown to have such a favorable influence upon combustion.

I did fear a loss resulting from the almost total suppression of the direct heating surface and the consequent reduction of the evaporating surface, the latter not even retaining the crownsheet. Experience has shown that my apprehensions on this second point were entirely without foundation.

To compensate for this partial suppression of the direct heating surface, I increased the diameter of the shell so as to be able to increase the number of tubes used, the boiler built after my plans having 306 tubes.

I was thus sure of having an excess of heating surface and of being able, without injuring the regularity of the service to be rendered by the locomotive, to plug a certain number of the tubes in order to determine whether the direct heating surface has the important influence that has been attributed to it up to the present time.

In order to compensate for the loss of steam space resulting from the removal of the shell from over the firebox, I

* From a paper by M. Docteur published in the *Revue Universelle des Mines.*

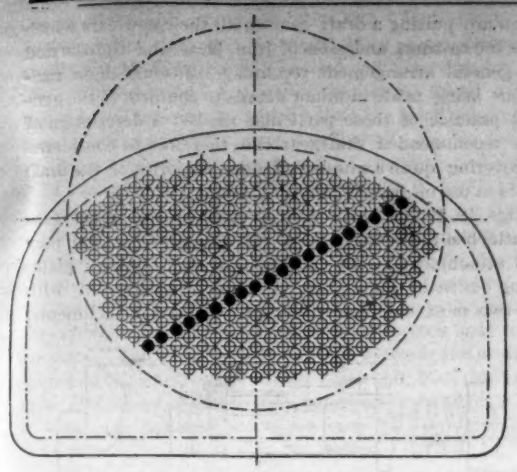


Fig. 3.

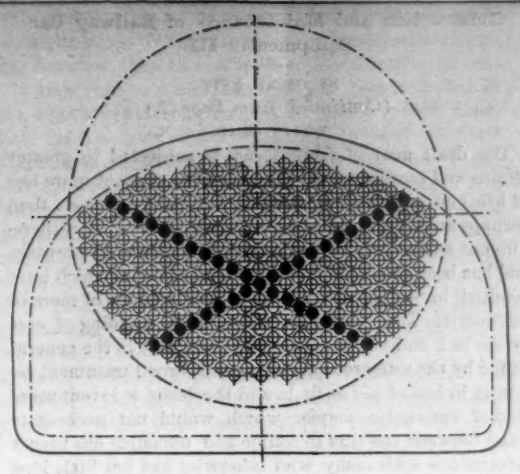


Fig. 4.

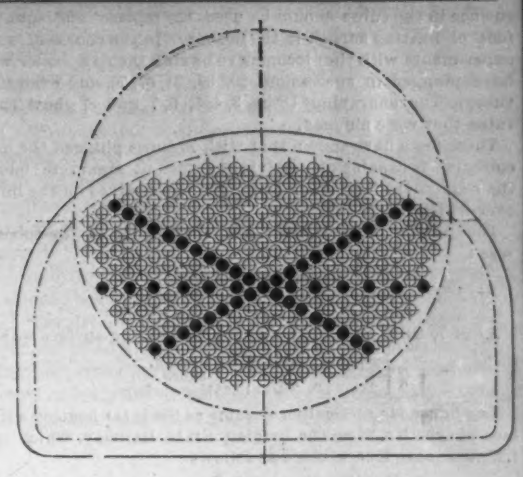


Fig. 5.

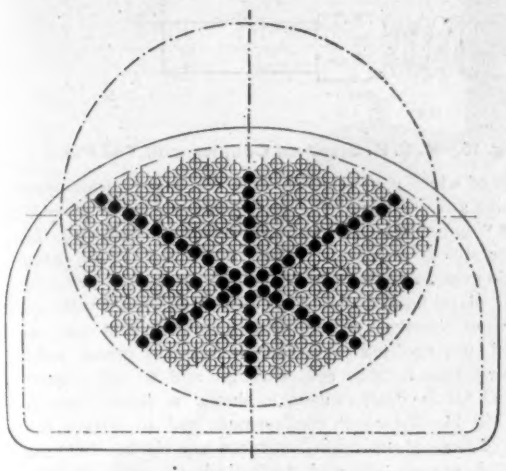


Fig. 6.

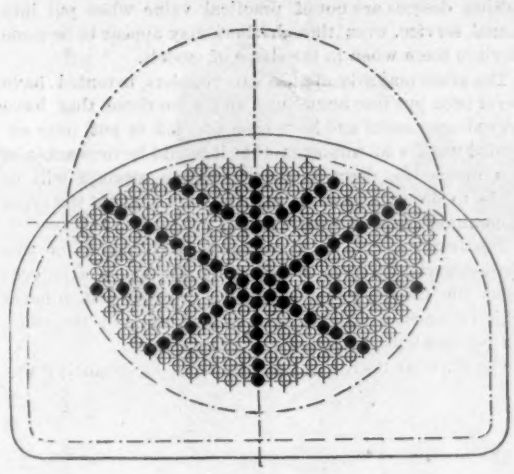


Fig. 7.

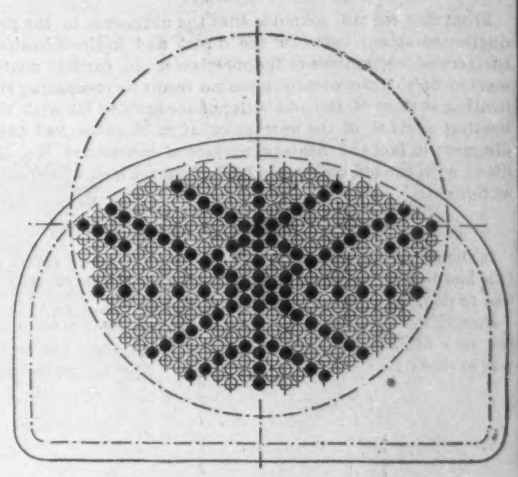


Fig. 8.

Diagrams Showing Tubes Plugged in Experiments on Amount of Tube Heating Surface Required with Firebrick Firebox.

have put a steam drum on the boiler at the front end. The cubic contents of this drum are about 24⅓ cubic feet more than the steam space of ordinary boilers, including that of the shell, above the crownsheet and the dome.

The supplementary drum is provided with manholes through which the boiler can be entered, and by which the throttle and dry pipe are rendered accessible. Fig. 1 shows the arrangement and appearance of a locomotive fitted with this new boiler.

It was important to definitely ascertain whether a wall of firebrick could be maintained in the firebox of a locomotive, to note the durability of such a wall in service and to make sure of the circulation of air about the bricks, as much for the purpose of keeping them cool as to make a delivery of hot air above the grates.

The results obtained prove that it is sufficient to increase the indirect heating surface by an amount equivalent to the direct heating surface suppressed in order to obtain a production of steam at least equal to that obtained under the original conditions; in fact, when the heating surface was reduced to that of the old boiler by the plugging of the tubes, there was no change in the regularity of the working of the engine. Therefore one square foot of direct heating surface has no more influence in the production of steam than the same amount in the tubes.

The tests of the new firebox with firebrick walls were made on locomotive No. 512, with outside cylinders and having the following principal dimensions:

Diameter of cylinder	19.1 in.
Stroke of pistons	26 in.
Steam pressure per square inch	142 lbs.
Diameter of driving wheels	4 ft. 11½ in.

Figures 1 and 2 show the outline of the old and new boilers.

The locomotive fitted with this new firebox was sent out from the Luttre shops on Feb. 20, 1894. From that time it has hauled trains Nos. 4,873, 3,874, 4,805, 3,331, 3,330, 4,163, 4,164 on the line running from Luttre to Brussels and Antwerp and back by way of Braine-le-Comte and also the trains running between Luttre and Tournai.

Care has been taken to keep an account of the production of steam in the new boiler; the consumption of coal by the engine, as well as the life and strength of the firebrick. Locomotive No. 512, coupled to the trains cited above, has hauled the load of a freight locomotive and the boiler has always furnished steam in sufficient quantities to insure the running of the trains without stalling or delays.

The results of the different tests to which it has been subjected show that the new boiler gives very satisfactory results when taken from the standpoint of the evaporation of water and that this evaporation sometimes amounts to from 8½ to 9 pounds of water per pound of coal burned when hauling through trains with a light load:

The combustion of coal in the firebox is perfect; this is due, in the first place, to the high temperature which is maintained in the firebox, whose walls are not constantly cooled by contact with water, as in the firebox of ordinary boilers; and, secondly, to the fact that the hot air which is admitted above the bed of coal that is burning upon the grate suffices to burn all the gases arising therefrom.

Furthermore, there are never any black spots upon the grates; when the coal is thrown in it is at once raised to such a temperature that it becomes incandescent immediately, and its gases are not distilled from it, as in the case of other fireboxes.

The temperature of the gases on entering the smokebox never exceeds 750 degrees Fahrenheit at a few inches from the tube sheet, as in the best freight locomotives.

There are fewer cinders in the smokebox than in the ordinary boilers; they are much finer and comparatively cooler.

The production of carbonic oxide is avoided; the flames developed in the firebox are always clear and evenly distributed over the whole surface; the production of heat in the firebox is very great and still the loss of heat due to radiation should be small on account of the firebrick sides, which have a thickness of 3.94 inches, besides a current of air passing around the bricks; also, the sheet metal covering that is outside the bricks has a lower temperature than that covering the ordinary firebox; it is possible, without any danger of being burned, to place the hand on this jacketing over the firebox of locomotive No. 512.

The admission of hot air, which circulates between the two parts and in the passages of the double wall, forms a perfect smoke preventative regardless of the quality of the coal used. For example, the new firebox has been fed successively with Flenu coal for furnace use, forge coal, pure semi-bituminous coals and a mixture of semi-bituminous and fine coal and in every test it was almost impossible to distinguish any difference in the haze of smoke issuing from the stack while the train was in motion.

The new firebox was fed with a mixture of three-quarters of fine coal and one-quarter of coking coal, and under these conditions 8 pounds of water was evaporated per pound of coal (see table 1,); 8½ to 9 pounds of water have also been evaporated per pound of coal, as we have already said; in hauling through freight, when the firebox was always at work, the evaporation has risen above 9 pounds.

The coal consumption of engine No. 512, when it had its old boiler with a small deep firebox using, on an average, the best quality of coal, has always been more than 80 pounds to the mile, while with the new boiler it dropped to 54½ pounds on a run of 11,700 miles.

There is another advantage possessed by the new firebox—the draft through the bed of coal is very much reduced by the hot air entering through the openings in the walls and when it comes into the firebox above the bed of coal, the result is that the coal is not carried into the smokebox and that it is even preferable to use lighter and finer coal.

The gases, although raised to a very high temperature in the firebox, seem to have lost much of this heat after passing through tubes 13 ft. 1⅛ in. long; in fact neither the smokebox nor its doors have ever been brought to a red heat by the temperature of the products of combustion.

Table No. 1, shows the trains hauled by the locomotive fitted with the new firebox, as well as the consumption of coal and water that has been observed during the experiments.

Table No. 2, gives: (1) the total amount of work done by this locomotive during the tests; (2) the total consumption of coal during the same period; (3) the allowance of coal attributed to the engine for the work which it has done.

The results given by these figures are very satisfactory, and can only be attributed to the change in the boiler; in fact, tests made in 1891 on the average working of the same locomotive with its old boiler are entirely unfavorable to its use.

All metal parts entering into the construction of the new boiler are in perfect condition up to the present time; no defects and no weakness have been detected even in the smallest pieces of the shell, and this is especially true of the firebox tube sheet, the special ring holding this sheet, and the different portions of the drum, etc. The water gages, the throttle lever and rods, although put in front of the firebox as in other locomotives, have given no trouble in handling and have given no annoyance to the driver.

Experiments have also been made with the boiler for the purpose of determining the effect of the direct heating surface of the firebox, and how many square feet of heating

TABLE NO. I.

Date of Test.	No. of trains hauled.	Consumption: Of Water in liters.	Consumption: Of Coal in kilograms.	Vaporation of water per kilo. of coal used.
March 1	3331	1,552	650	10.00
" 3	4804	7,128	950	7.50
	4873	4,697	650	7.22
" 6	4874	8,701	1,200	7.25
	4873	4,389	600	7.31
" 9	4874	8,239	1,100	7.49
	4873	6,160	850	7.24
" 14	4874	7,354	1,050	7 45
	4873	6,282	750	8.25
" 16	4874	7,084	850	8.33
	4873	4,740	675	7 00
" 20	4874	8 930	1,100	8.11
	4805	3,773	475	7.90
" 21	3330	5,383	750	7.17
	4873	4,543	600	7.57
" 23	4874	5,994	750	7.99
	4873	5,600	750	7 46
" 27	4874	8,208	1,000	8.20
	4163	9,702	1,050	9.24
" 28	4164	16,863	2,050	8.22
	4873	6,008	700	8.58
" 30	4874	7,161	850	8.42
	4873	4,387	600	7.30
April 3	4874	8,085	950	8.51
	4805	4.881	650	7.50
" 4	3330	5,390	675	8.28
	4873			
" 5	4874			
	4805			
	3330			
" 7	3331			
	4805			
	3330			
" 10	3331			
	4805			
	3330			
" 11	3331			
	4873			
	4874			
" 13	3331	4,312	600	
	4804	5,390	750	

NOTE.—There were 20 tubes plugged on trips of March 23 and 27, 39 plugged on the 28th and 30th, 51 on April 3, 64 on April 4, 5 and 7, 76 on the 10th, 100 on the 11th, and outbound trip of the 13th, while on the return trip of the 13th the admission of air above the fire was cut off.

TABLE NO. II.

Time of test.	Run of the locomotive in kilometers	No. of actual units hauled.	Consumption: Of bituminous coal	Consumption: Of fine coal.	Total.	Allowance of fuel.	Consumption: Of coal per kilometer.	Consumption: Per virtual unit hauled.
February	339	25.984	1.600	3.000	4.600	7.315		
March	1.462	119.858	8.600	16.400	25 000	33.444		
April	856	68.776	3.000	9.600	12.600	17.707		
jusqu'au 13.								
	2.656	214.618	13.200	29.000	42.200	59.866	15.88	0.19

Saving 17,616 kilometers, or 33 per cent.

surface in the tubes should be used to replace one square foot of heating surface in the firebox. In the course of our experiments with the locomotive having the new boiler we have plugged in succession, 20, 39, 51, 67, 76, and even 100 tubes. The engravings (Figs. 3, 4, 5, 6, 7 and 8) show the tubes that were plugged.

These tests have shown that with 76 tubes plugged, the locomotive is capable of supplying sufficient steam to haul the regular train assigned to freight locomotives on the line over which it was run.

The heating surface, before the plugging of the tubes, was:

15.57 square feet in the firebox.
1,707.21 " " " tubes.
1,722.78 " " total heating surface.

After 76 tubes had been plugged the heating surface was:

15.57 square feet in the firebox.
1,283.22 " " " tubes.
1,298.79 " " total heating surface.

The figure is practically the same as the total heating surface of type No. 25 on the Belgian State Railway, which is 1,299.06 square feet, divided as follows:

1,176.75 square feet in the tubes.
122.31 " " firebox.

From this we can conclude that the difference in the production of steam between the direct and indirect heating surfaces of locomotives is inappreciable. In further confirmation of this we obtain the same result by comparing the heating surface of the old boiler of locomotive 512 with the heating surface of the new boiler after 76 tubes had been plugged; in fact the heating surface of locomotive No. 512 fitted with the old boiler was 1,263.24 square feet, distributed as follows:

1163.43 square feet in the tubes,
99.81 square feet in the firebox.

It should be remembered that the production of steam in this last boiler was always insufficient for the work that it had to do.

Finally we would call attention to the last tests made with the new firebox, where the draft of air through the walls was entirely stopped; these experiments showed an instant diminution in the production of steam, an increase in the consumption of coal, and a far less perfect combustion of the fuel in the firebox.

The use of refractory materials in the fireboxes of tubular boilers demands special care in the installation, the necessity for which was recognized at the time the boiler was fired for the first time, which was upon Dec. 15, 1893, and before all the work upon the engine, such as placing the lacketing, etc., had been completed.

It is important that the admission of cold air should be avoided to as great an extent as possible, when the bricks are heated to a white heat, and that the fire should not be hauled immediately after ending a run, but should be allowed to die out gradually.

It has been stated that in proceeding in this way the steam pressure will be maintained for several hours.

Steam has always been raised, even from cold water, in one and a half hours, while, with the ordinary boilers, it requires at least three hours.

The expansion of the shell has been measured with great accuracy by means of points on the frame, and it has not exceeded from .15 to .20 inches.

We may consider that this boiler is perfectly safe, for it consists of a cylindrical shell and tube sheets braced by the tubes as well as by re-enforcing sheets and ties. The tube sheets were found to be perfectly flat after a run of 11,625 miles.

Finally, this boiler effects a considerable saving in invested capital, as compared with the boiler of an ordinary freight locomotive having approximately the same dimensions; the saving is estimated at 5,000 francs ($1,000) per boiler.

Expense of a complete renewal of the brickwork (materials and labor) does not exceed 100 francs ($20) and can be done by an ordinary mason in three days.

It should be remembered that the expense of merely replacing a few staybolts in an ordinary boiler frequently exceeds this amount. Furthermore, by the use of this new type of boiler, a saving of from 10 per cent. to 12 per cent. in fuel can be made when air is admitted above the grate.

Construction and Maintenance of Railway Car Equipment. III.

BY OSCAR ANTZ.

(*Continued from Page 22.*)

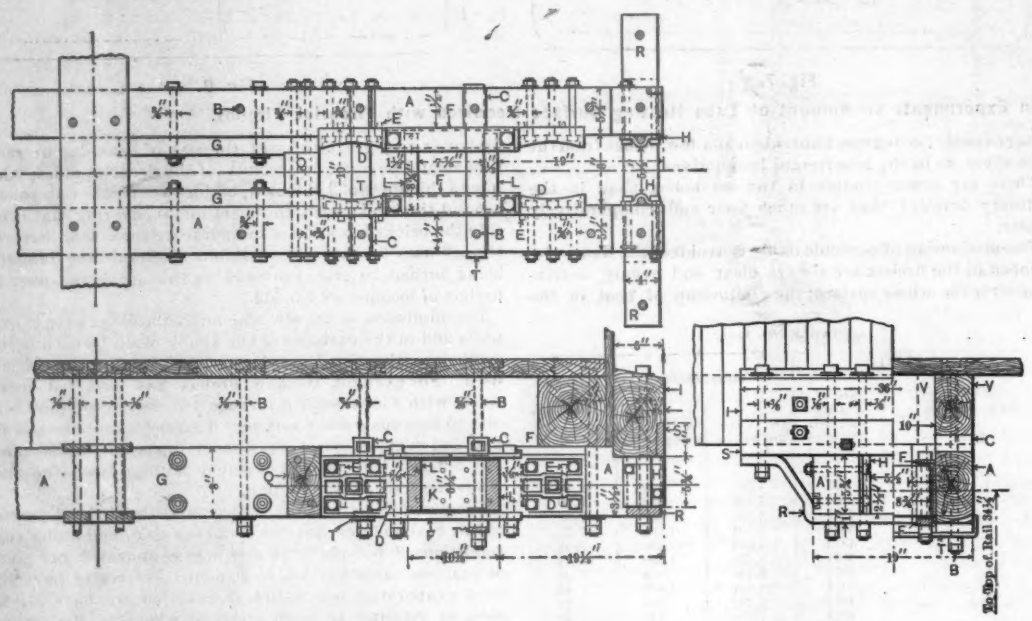
DRAFT GEAR.

The draft gear of freight cars is subjected to greater strains and more abuse and has been the cause of more loss of life and of more injuries to railroad employees than perhaps any other part of railroad equipment. It is therefore but natural that it has received considerable attention and has been the subject of many experiments which have resulted in numerous inventions and designs of more or less merit. The danger attendant to the coupling of cars by the link and pin has been made manifest to the general public by the numerous accidents to railroad trainmen, resulting in loss of life or limb, and the desire to invent some kind of automatic coupler which would not necessitate going between the cars to couple and uncouple has been a favorite one with many who otherwise had but little idea of practical railroad work. Naturally, many of the resulting designs are not of practical value when put into actual service, even though there may appear to be some merit in them when in the shape of models.

The great majority of the car couplers invented have never been put into actual use, and even those that have proved successful and have been adopted or put into extended use are so numerous that it would be impossible in this article to describe them; and no attempt will be made to do it; a general description of some of the types in common use only will be given.

The draft gear can be considered as consisting of two distinct parts, viz., the coupler or drawbar, which connects the cars together, and the drawbar attachments which connect the drawbar to its own car and transmits pulling and buffing strains to the framework.

The drawbar itself can be considered as consisting also of two distinct parts, the front or coupling part, which couples with another drawbar and the rear end or shank, by which it is connected to the draft gear of its own car. The front end is independent in its design on the method of attachment at the rear end.



Figs. 12 and 13 Fig. 14.

Draft Gear for Freight Cars Recommended by the Master Car Builders' Association.

The M. C. B. Association has adopted as standards certain sizes and relations of parts of the drawbar, without recommending any one particular construction, the type adopted being the so-called vertical plane coupler, which does not require the use of a link and pin. Only the outline of the parts which come in contact in coupling are laid down, the details of construction being left to the individual judgment of the inventor or car builder. This contour line is shown in full lines at *X X* in Figs. 15 and 16, and some of the couplers will be described in detail in a future article.

The drawbar attachments on the frame of the car, while they vary greatly in detail, still have some general points of resemblance, and may be described as consisting of lugs or stops attached to the center sills (either direct or through the intervention of draft timbers), against which large washers or plates are placed, and to which are transmitted the pulling and buffing strains of the drawbar, springs being introduced to lessen the shocks.

Attempts have been made to have other parts besides the drawbar adopted as standards, but there is such a vast diversity of opinions, that as yet no design has been made which meets the approval of all or even a majority of the car builders. The nearest approach to uniformity which has been made is the recommendation by the M. C. B. Association of a certain design which is considered as good practice. Many roads have draft gears which approach very closely to this design, the variations being principally in the details, and while the design has not been adopted exactly as submitted by any road, some of them are putting a draft gear on all their new cars which uses the castings and sizes of iron, bolts and timbers and the general arrangement recommended, some slight variations being made in minor details to conform to the general practice of those particular roads. A description of this recommended draftgear can therefore be considered as covering quite a number, if not a majority of the draft gears in use on freight cars in this country.

Figs. 12, 13 and 14 show three views of this draft gear as attached to the frame of a car, the drawbar and rear end attachments, with exception of the follower plates being omitted. Figs. 15 and 16 show the drawbar, with the two most common styles of rear end attachments,

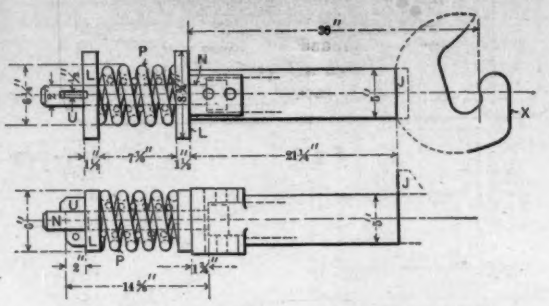


Fig. 15.—M. C. B. Standard Coupler with Tail Pin.

either of which can be used with the above draft gear without any changes. The draft timbers *AA* are of oak, 5½ by 8 inches in section, and are fastened securely to the center sills by means of ¾-inch bolts, *BB*, which have double nuts on the bottom, the heads resting in cast-iron socket plates let into the floor. When the center sills do not come directly over the draft timbers, they can be furred out by bolting pieces to their sides, to obtain solid timber for the bolts to pass through, and to get a good bearing for the draft timbers, as shown in dotted lines at *VV*, Fig. 14. To resist displacement and to relieve the bolts of some of the strains, cast-iron key blocks, *CC*, are inserted between sills and draft timbers, being let into each and held in place by bolts passing through them. With iron body bolsters the rear ends of the draft timbers are usually passed through between the two members, with shoulders against these, and extending about 18 inches or 2 feet beyond; stiffening pieces are then added to fill up the space between the ends of the draft timbers and the crosstie timbers. When wooden body bolsters are used the ends of the draft timbers are fitted against these.

The front ends of the timbers pass under the end sill and, when wooden face blocks are used, these drop down below the end sill about 1½ inches and the draft timber is cut away the same amount, forming a shoulder.

The inside of each draft timber is cut away 1 inch for a certain distance, and against the shoulders thus formed, the cast-iron drawbar stops *DD* are fastened. There is quite a variety of these castings, of all shapes and sizes, and the ones shown are about as strong and heavy as any in use; they are fastened to the draft timbers by five ¾-inch bolts the heads of which are next to the casting and are prevented from turning by ribs on the casting; the nuts rest on plate washers and are prevented from turning by pieces of hardwood nailed to the timbers, which can be easily removed in case the bolts have to be taken out. To further secure the castings, lugs, ¾ inch square in section and 5 inches long, *EE*, are cast on the back and let into the draft timbers. Cylindrical lugs of about 1 inch in diameter are sometimes used instead, but they are broken off easily and are therefore not very reliable. There are two castings to each timber, one to take the pulling and one the buffing strains. The two castings are connected together on top and bottom by wrought iron drawbar-guides, *FF*, which transmit some of the strains from one to the other, and also act as a guide to the follower plates. They are made of ¼ by 2½-inch or ¾ by 2-inch

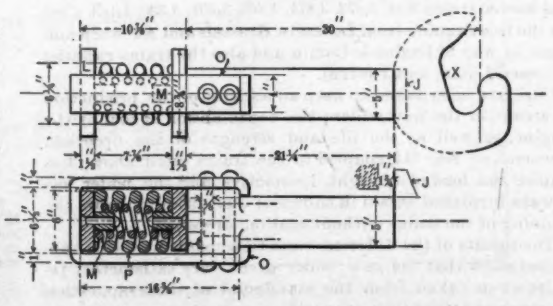


Fig. 16.—M. C. B. Standard Coupler with Strap.

iron and are fastened to the castings by ¾-inch bolts. When no timber comes directly over these bolts the top guide is turned up at the ends to prevent the bolts from turning, the bottom ends being provided with lock nuts. When there is a timber above them the bolts are carried through this and the floor and their heads rest in cast iron sockets let into the latter.

The draft timbers are sometimes re-enforced by additional timbers, *GG*, placed between the back drawbar stop and body-bolster and tied to them by ¾-inch bolts; these timbers take some of the buffing strains.

The two draft timbers are tied together back of the drawbar stops by two ¾-inch bolts passing through from one

to the other, through a distance piece, QQ, 4 inches wide, fitted between the timbers or the re-enforcing pieces. Other ties, *TT*, of ⅜ by 2½-inch wrought iron are placed under, the draft timbers at or near the drawbar stops, lipped up on the ends and fastened by ¾-inch bolts; the front one has distance pieces under it to lower it sufficiently for the follower plates to work. The front ends of the draft timbers are tied together by the drawbar carrier-iron, *R R*, of 1 by 4-inch wrought iron, which also acts as a support for the drawbar, the draft-timbers being cut out on the bottom to receive it. The ends of this iron are bent up and fastened to the under side of the face block, or, when this is not used, to the endsill. Six ¾-inch bolts hold this iron in place, four at the center and one in each end, all having lock nuts on the bottom. The two inside bolts come between the draft timbers and close to them, and over these bolt draft timber guards, *HH*, 5¼ inches high and preferably made of malleable iron, are fastened, each by two ¾-inch bolts; a rectangular opening 5¼ inches wide and 5¼ inches high is thus formed between the timbers in which the drawbar works. This opening has been adopted as standard by the M. C. B. Association, as has also the section of the drawbar at this point, viz., 5 by 5 inches.

The drawbar projects a certain distance beyond the end of the draft timbers, the standard adopted by the M. C. B. Association being 10½ inches to the center of contact between the couplers of two cars when there is no strain on them; this would leave only 21 inches between the two cars if the draft timbers were to end at the endsill, which would hardly be sufficient to allow a person to step between the cars, and it would be still less if the draft springs were compressed. When the endsills are on the outside of the sheathing, they are generally tapered down at the ends to increase the space between the cars, but to increase it considerably for at least part of the width of the car, face blocks, *II*, are fastened to the endsills above the draft timbers, and the draft gear is carried ahead a distance equal to the thickness of this block, thus increasing the distance between the bodies of the cars by double the amount. These face blocks also strengthen the endsill at its weakest point, and as they take all the wear due to the working of the drawbar, the cost of repairs is considerably reduced, as they can be renewed much more readily than the endsill.

This face block is made of oak, usually about 36 inches long and 6 by 9 inches in section, and is securely bolted to the endsill, two of the bolts often passing back and ending in plates which lip over the body bolster. On the front bottom edge of the face block a protecting plate, *S S*, is fastened, against which the horn *JJ* of the drawbar strikes when the latter is pushed in, forming a stop for it. This plate is made of ¾ or 1 inch by 4 inches wrought iron and sometimes of angle iron. The distance between its face and the horn of the drawbar is 1¾ inches when there is no strain on the bar, which is another standard of the M. C. B. Association.

The inside of the draft timbers between the drawbar stops is sometimes protected by a plate of ¼ by 6 inches wrought iron, *KK*, secured by countersunk wood screws, which prevents the follower plates from chafing the timbers.

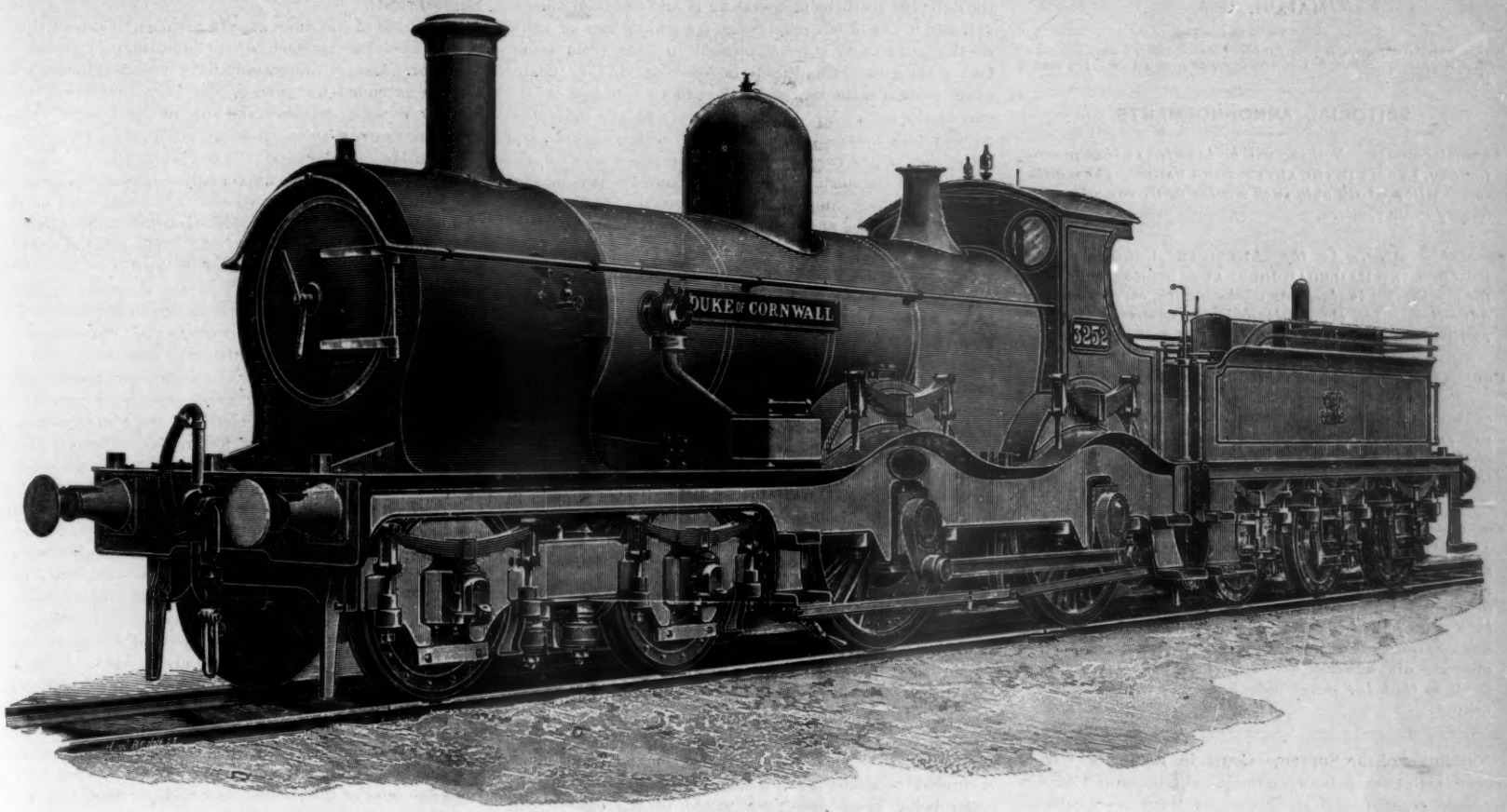
The follower plates, *LL*, are two in number, the M. C. B. standard size being 6 by 8½ by 1½ inches, and are made of wrought iron. When a spindle is used to connect them to the drawbar, they have a 2½-inch hole through the center; with a yoke or pocket connection a hole is drilled in them, countersunk on the outside, to take a ¾-inch rivet, which fastens a cast-iron thimble, *MM*, to hold the draft springs in place. The earlier drawbars and many in use to-day are connected to the follower plates by means of a spindle or tail pin, *NN*, as shown in Fig. 15. This pin is 3 inches in diameter, and its front end is provided with a head, either rectangular or cylindrical, with a flat space to prevent its turning; the rear end is either threaded for a nut or preferably has a slot in it to take a ¾ by 2-inch wrought-iron or steel key, *UU*, which is prevented from working out of place by a ring or cotter pin.

It was soon found that this spindle connection was not as reliable as was desired, as the head became worn, allowing the drawbar to be pulled off the pin, or the latter would break, or the key would break or work out, allowing the drawbar to drop on the track, where it formed a dangerous obstruction and has been the cause of numerous wrecks. Another objection to the spindle connection is the large hole required in the follower plates.

These objections are overcome as shown in Fig. 16 by substituting a strap of wrought iron, *OO*, bent in the shape of a U and fastened to the top and bottom of the shank of the drawbar, forming a pocket, in which the follower plates and draft spring are placed. This pocket strap, or yoke, is made of 1 by 4-inch wrought iron with an opening 6½ inches wide and as long as is required for spring and follower plates, ½-inch being allowed for compression of the spring. The strap has hooks turned on the ends which lip over projections on the shank of the drawbar, and it is fastened to the latter by two 1½-inch rivets, excepting on some constructions of draft gear in which the strap has to be taken off to remove the drawbar, in which case bolts are used instead of rivets.

The draft spring, *PP*, as recommended by the M. C. B. Association is 6½ inches in diameter and 8 inches long, made of two coils of round steel, 1½ and ¾ inches respectively, in diameter, the spring to have a total resistance, when fully compressed, of 22,000 pounds, and capable of being compressed 2½ inches.

(To be continued.)



New Passenger Locomotive for the Great Western Railway of England.

Passenger Locomotive for the Great Western Railway.

In the accompanying engraving we illustrate the latest of fast passenger locomotives built by the Great Western Railway of England. Ten of these engines have been constructed at the company's shops at Swindon. They were designed by Mr. W. Dean, locomotive superintendent, and are intended for service on divisions where the grades are heavy and the curves both sharp and numerous.

The engines are somewhat American in appearance, with their four-wheeled leading trucks and extension fronts. The cylinders are 18 inches by 26 inches and are between the frames. The driving wheels are 67½ inches in diameter, which is considered rather small in English practice, but was decided upon in this case because of the heavy grades. The boiler is straight and is constructed of steel, with steel tubes. There is nothing unusual about it except the extension front already alluded to and the staying of the firebox crown. The front half of the crown is stayed by longitudinal bars, the front ends of which rest on the flange of the tube sheet, while the rear ends are suspended from the shell by heavy sling stays. The rear half of the crown sheet is stayed by short transverse bars of inverted ⊥ section, supported by sling stays to the shell. These transverse bars are only one-half the width of the box in length. This peculiar staying is employed to avoid rigidity. The boiler carries 160 pounds pressure.

The main driving axles have journals inside and outside of the wheels, but on the rear axles there are outside journals only. The driving springs are without any equalizing arrangement of any kind, and are peculiarly disposed in that while there is one spring over each rear journal there are two sets of main driver springs; one set is placed over the outside journals and the other set is under the inside boxes. The weight on the main wheels is considerably more than on the rear ones.

The principal dimensions of the engines are as follows:

Cylinders	18 inches by 26 inches.
Driving wheels	5 feet, 7½ "
Truck wheels	3 " 7½ "
Driving wheel base	8 " 6 "
Total wheel base	22 " 2 "
Diameter of boiler	52⅛ inches O. D.
Number of tubes	249
Size of tubes	1¾ inches O. D. by 11 feet 3¼ inches long.
Heating surface of tubes	1,285.6 square feet.
" " firebox	112.6 " "
Total heating surface	1,398.2 " "
Grate area	19 " "
Boiler pressure	160 pounds.
Weight on main drivers	34,400 "
" " rear drivers	29,500 "
" " truck	39,200 "
Total weight in working order	103,100 "
Tender capacity	2,000 gallons.

We are indebted to *Engineering* for our illustration.

Water-Tube Boilers in the British Navy.

Evidently the English Admiralty retain their faith in the efficiency of water-tube boilers, as not only are a large number of new vessels being fitted with various designs of these boilers, but it has also been decided to reboiler No. 80 torpedo boat and the cruiser *Bellona* in each case with water-tube boilers. The *Bellona* is only four years old, and, although this vessel has done very little service, the boilers are reported to be considerably worn. The cruiser *Proserpine*, building at Sheerness, is also to be supplied with water-tube boilers. It is stated that the Thornycroft type will be adopted in this case.

According to *Engineering*, *H. M. S., Vindictive*, a second-class cruiser of 10,000 indicated horse-power, just laid down at Chatham Dockyard, is to be fitted with water-tube boilers of the Belleville type, 18 in number, by Messrs. Maudsley, Sons & Field, Limited, who are making the feed pumps, also of the Belleville type, and the air blowers or compressors for supplying air to each furnace to mix with the gases and aid combustion. The boilers are arranged in three groups, each group consisting of six boilers placed back to back, with the athwartship stokeholds. Each boiler is constructed for a working pressure of 300 pounds per square inch, and consists of eight elements, ten stories high, built of solid drawn steel tubes 4½ inches in diameter and seven feet, six inches long. The boxes connecting the tubes are of malleable cast iron. The total grate surface is 880 square feet, and the total heating surface is 25,600 square feet. There are six feed pumps, each capable of feeding six boilers and six air blowers; that is, one feed pump and one blown in each stokehold. The boiler installation is identical with those of the second-class cruisers *Gladiator*, *Furious* and *Arrogant*.

(Established 1832.)

AMERICAN ENGINEER
CAR BUILDER AND RAILROAD JOURNAL.

27TH YEAR. 65TH YEAR.

PUBLISHED MONTHLY
BY
R. M. VAN ARSDALE,
MORSE BUILDING.....NEW YORK.

M. N. FORNEY,
W. H. MARSHALL, } Editors.

F. H. CLARKE, Advertising Manager.

MARCH, 1896.

Subscription.—*$2.00 a year for the United States and Canada; $2.50 a year to Foreign Countries embraced in the Universal Postal Union.*

EDITORIAL ANNOUNCEMENTS.

Advertisements.—*Nothing will be inserted in this journal for pay,* EXCEPT IN THE ADVERTISING PAGES. *The reading pages will contain only such matter as we consider of interest to our readers.*

Special Notice.—*As the* AMERICAN ENGINEER, CAR BUILDER AND RAILROAD JOURNAL *is printed and ready for mailing on the last day of the month, correspondence, advertisements, etc., intended for insertion must be received not later than the 25th day of each month.*

Contributions.—*Articles relating to railway rolling stock construction and management and kindred topics, by those who are practically acquainted with these subjects, are specially desired. Also early notices of official changes, and additions of new equipment for the road or the shop, by purchase or construction.*

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The action of the Supreme Court in issuing a writ of certiorari in the suit between the Westinghouse and Boyden air-brake companies is significant as being practically an admission of error in the decision of the Circuit Court of Appeals. This is the first patent case, not involving Federal interests or a question of jurisdiction, that has ever, under the method of procedure established by the statute of 1891, been ordered up for further action by the United States Supreme Court. Its decision will be awaited with interest and we trust that when rendered the decision will be so manifestly just to both companies as to be so considered by all parties.

It is popular in these days to decry the methods employed in departments of the government, and perhaps no one department receives more abuse than the patent office. Possibly it deserves some of it, but those who condemn the accumulation of a surplus in its treasury that in many years has risen to only $4,500,000 should be less hasty. During the last year or two great progress has been made in the classification of patents and in bringing the work up to date, so that there is less delay in the issuance of patents. We recently heard of a patent being allowed in about three weeks after application was made. It is hardly to be presumed that the work of reform is going to cease, and as reforms require money to carry them out, this surplus may actually decrease in the near future. Certainly it is better to urge reasonable reforms, even if they be extensive, than to advocate reduced fees as a means of wiping out the surplus.

In shops where the character of the output is such that manufacturing methods cannot be generally introduced throughout the entire plant, there are usually opportunities to employ these economical methods in the details. A shop that is building a certain line of engines on order, for instance, need not limit the number of small parts made at a given time to the orders then on hand for engines, but can make them up in fifties or hundreds, if too much capital is not tied up thereby. This method of working has been pretty well developed in some railroad repair shops to the profit of the company. To get the fullest benefit from such practices unimportant variation in the details of cars and locomotives must be avoided, and standards departed from only when absolutely necessary. This widens the field for manufacturing in the making of repair parts, makes the demand for any given part more regular, reduces the amount of stock to be carried and the capital tied up in finished parts. This is realized by many, but not every road gives it the attention it warrants, because of a mistaken impression that the number of pieces of any one part required by it are not sufficient to make such methods profitable, or to pay for the special tools by which the cost for labor is reduced.

After two years of trial, the Pittsburgh, Cincinnati, Chicago & St. Louis Railway has abandoned the "chain-gang" method of handling its motive power, and has returned to the practice of crews to each engine. Whether they are operated with single or double crews depends upon the amount of traffic and the demand for engines. Mr. Swanston, Master Mechanic at Indianapolis, finds by a comparison of accounts for different years that the "chain-gang" system resulted in an increased cost of roundhouse expenses of 11 per cent., that the engines had to be shopped more frequently, the passenger engines averaging about 20 per cent. less mileage between shoppings, and the freight engines 24 per cent. All this happened without any increased mileage per month as an offset. Exact information relative to the different methods of operating is and has been hard to get, and if any of our readers can contribute data of value on this subject we will be pleased to hear from them. One of the great difficulties to be overcome in the "chain-gang" system is the lack of interest in the engines on the part of the men. Mr. Swanston says that the individual crew system makes better machines of the engines, and better men of the crews. With the responsibility for the condition of the machine, he argues, comes a personal interest in it which must result in advancing their knowledge of the engine and making them more valuable men.

On another page we publish an account of interesting experiments made in France with a locomotive having a boiler whose firebox was lined with firebrick. From a theoretical standpoint a firebox devoid of heating surface should give more combustion and prove more economical than one having heat-conducting walls, providing the remainder of the boiler contains heating surface capable of reducing the temperature of the gases at the smokebox to the best practice of to-day. But those who consider the 160 square feet, more or less, of firebox heating surface as indispensable to good steaming qualities, it may appears to be impracticable to depend upon the tubes alone for heating surface. Nevertheless, it has been proved by several investigators working independently of each other that tube-heating surfaces can be relied upon to perform the additional duty demanded of them, without as great an increase in total heating surface as would at first be thought necessary. But while this is all true, our readers may be cautious in accepting the conclusion of the author of the article found in this issue that firebox heating surface can be satisfactorily replaced by an equal number of square feet of tube surface. That results supporting that view were obtained in the trials noted is probably attributable to the duty imposed on the boiler being much less than would be the case in this country. While the rate of combustion is not stated in the article, it is said the coal burned per mile was reduced from 80 pounds to 54½ pounds, and at ordinary speeds of freight trains that would involve the combustion of about 1,600 pounds per hour. As the tube heating surface in the new boiler, which approximately equaled the total heating surface of the old boiler, was 1,299 square feet, it follows that for each pound of coal burned per hour there was .81 square feet of heating surface. The common practice in this country is to load engines with all they can haul and the combustion per square foot of grate and per square foot of heating surface is almost always greater than in Europe. The average combustion here can be safely taken at one pound of coal for not more than .5 of a square foot of heating surface per hour, thus imposing a duty upon the heating surfaces of approximately 60 per cent. more than in the French experiment. Had the boiler been called upon to do the amount of work required in American practice all of the extra heating surface of the new boiler might have been required. While one of the avowed purposes of the test was to determine the durability of the firebrick walls, the author has not stated in his article what mileage was obtained from them.

A NEW ENGLISH LOCOMOTIVE.

On another page we reproduce from *Engineering* a perspective view of a new passenger locomotive, built for the Great Western Railway, by Mr. W. Dean, Locomotive Superintendent of that line. As this engine has some peculiarities, and as it differs very much from American practice in some respects and approaches it in others, a little criticism, comment and comparison with our way of doing things, may not be unprofitable to some of our readers on this side of the Atlantic, nor uninteresting to those on the other. What is proposed is simply to make such comments on these differences of practice, which strike an American, who has taken an active interest in locomotive construction and design, and to point out wherein the English and wherein the American practice seems to have advantages. It may be added that accompanying the view, which is reproduced on another page, *Engineering* gives a double page longitudinal section and sectional plan for which we had not room, but from which much of our information was derived.

As will be seen from the engraving, which is given elsewhere, the engine is of the bogie type with inside cylinders, and—what is very remarkable for an English engine—an extended smokebox. The wheel base, measured from the center of the truck to the center of the trailing wheels, is 19 feet. An American engine of similar size and weight would be made about 18 inches longer. This difference in length is a marked characteristic which differentiates English from American practice. Apparently the necessity of making the length of their locomotives, which have rigid wheel bases, very short has become a habit, so strong in the minds of our English brethren that it cannot be laid aside when then there is no longer any necessity for conforming thereto, or the length of existing structures, such as engine houses, turn-tables and sidings, on their roads, is too short for locomotives of a greater length than they have adopted. All American locomotive men would be unanimous that there is not the slightest need of making our locomotives shorter than they are in order to traverse any ordinary curves found on lines in this country or those on English roads.

The length of the tubes of "The Duke of Cornwall" are 11 feet 3¼ inches between tube plates, and 1¾ inches in diameter. Longer tubes would have been practicable with a more extended wheel-base, and they then could have been increased in diameter and still retained their evaporative efficiency, with less liability to clogging up.

The inside cylinders and cranked axles are constructive features which would be universally condemned here. In this engine the driving-wheels are small, and as the steam chests and valves are placed below the cylinders, the latter had to be inclined 1 in 10. The opinion, or prejudice possibly, against the use of inclined cylinders on locomotives is so strong in this country that any engineer who would adopt them in the construction of a locomotive, unless it were under very exceptional circumstances, would be regarded here as a superannuated mechanical fossil. Now, it may be that this is an entirely unreasonable prejudice, but of its very general prevalence here there can be no doubt. In England, on the contrary, many, perhaps most, of the ablest locomotive superintendents still adhere to this method of construction. Who is nearest right? The arguments *pro* and *con* have often been stated. It is claimed for the inside cylinder engines that they run steadier, and that their cylinders are better protected from radiation, and also that the framing can be more compact and stronger than with outside cylinders. On the other side is the fact that cranked axles are first much more expensive and more liable to break than straight ones. To lessen this liability Mr. Dean has provided double bearings for the main driving axle, which are inside and outside the wheels. The trailing axle has only outside bearings. The crank cheeks are also reinforced with straps shrunk on them. The double bearings require duplicate frames, journal boxes and driving springs and supplementary outside cranks and pins for the coupling rods. Owing to the large diameter of the inside crank bearing the "big end" of the connecting rod must be about double the linear dimensions and its weight about four times that of a rod for an outside connected engine. On Mr. Dean's engine the forward part of the connecting rods are made with forked ends and double strap bearings—but this is not essential. It is nevertheless expensive, although it makes a good job when finished.

Another objectionable feature is that the firebox must be about a foot shorter with cranked axles—to give clearance for the cranks—than it need be with outside cylinders. This may not be a serious objection where good coal is used, but with poor fuel the additional length of firebox is important.

Doubtless better drainage of the cylinders is secured, by placing the steam-chests below them, and inverting the slide-valves than there would be if they were placed on top, but in the engine which is now being discussed the steam chests are immediately above the center bolster of the truck, which has an arrangement that permits of its transverse movement in relation to the engine. It is not easy to see how the valve-seats can be faced without removing the truck, and then the workman must operate on an inverted surface like the ceiling of a room. It is to be feared that such an arrangement would cause a good deal of profanity in American roundhouses if that method of construction was generally adopted here. It would be interesting to have an estimate of the cost of a set of cylinders, connecting-rods, crank-axles with duplicate boxes, springs and frames and outside cranks, and then compare it with the cost of the same parts as ordinarily made for outside cylinder engines. What American locomotive engineers would be interested in knowing is the compensating advantage for this difference in cost.

It is of course true that by placing the cylinders between the wheels, and inclining them, and then putting the valves below them, that the links can be connected directly to the valve-stems on a horizontal line drawn through the center of the driving-axle. European designers of locomotives appear to have abhorrence of rocking-shafts and they will resort to all kinds of expedients to avoid their use. Now, as a matter of fact, there is hardly anything about an American locomotive which costs so little to maintain as the rocking-shafts which are used here with link-motion valve-gears, and probably nine master mechanics out of ten in this country would much rather maintain and lubricate such "rockers" than keep up the sliding guides for the valve-stems, which are directly connected to the links as they are shown in the

illustration before us. The bearings of a rocker are cylindrical and are enclosed and are never exposod to dust. A reciprocating guide, on the contrary, has a considerable part of its frictional surface exposed during each stroke and is thus more difficult to keep oiled and more subject to wear. Besides the bearings of the rocker are more accessible, which is an important feature, which leads to the observation that English designers seem to take great pains to hide all appearance of complication, and to do this, are given to putting everything that it is possible to hide inside, where it will be out of sight, or, in the language of St. Paul, they "look on things after the outward appearance." American designers, on the contrary, try as far as possible to put all working parts outside, where they will be accessible.

The boiler of Mr. Dean's engine is made of steel, with steel tubes, the staying of the crownsheet being quite peculiar. The rear half of its surface is provided with transverse crown stays, the general form of which is that of an inverted letter ⊥, the vertical and horizontal parts of which are united by a pin connection. The lower portions of each of these ⊥'s extends from the outer edge of the crownsheet to the middle and is connected to it by crownbolts. The upper edge of the ⊥ is attached to the outside shell. The front half of the crownsheet, on the other hand, is supported by longitudinal crownbars, which are only half the length of the crownsheet and each of which has its front end resting on the tube plate, while its rear end is hung from the outside shell or "casing" of the firebox by a pivotal pin and sling stay. Between the two ends the bars are connected to the crownsheet by bolts. "This system," *Engineering* says, "has evidently been adopted with a view of avoiding too great rigidity, and allowing for expansion." With this arrangement the front ends of the crown bars are free to move up or down with the expansion of the tube plate and of the firebox. The back ends are, however, supported by the sling stays, while the part of the sheet between the ends of the bars is supported by the bolts. A somewhat similar action may take place with the transverse ⊥ stays, the horizontal part of which may rock on its pin connection with the vertical part in case the side sheets are expanded. This method of staying seems to have merits which are well worthy of consideration.

A feature which is worthy of consideration by American engineers is the construction of the driving-springs. These are 3 feet 6 inches long, measured from center to center of hangers, and consist of four plates of 4 by ⅝-inch and four plates of 4 by ½-inch steel. The hangers of both the driving and truck springs are supported by cylindrical rubber pads 5½ and 4¾ inches diameter and 3 inches thick. These are held in cast-iron cages or boxes, the link hanger being a round rod with a nut and a washer below the rubber, the springs being connected to the upper ends of these hangers by links which permit the free movement of the springs. This is a much better arrangement than is ordinarily provided in American engines, although the absence of equalizing levers between the driving axles would hardly be approved in this country, but with a good roadbed and the excellent arrangement of springs provided by Mr. Dean, it is an open question whether equalizers are essential or important.

The driving tires have safety flanges which lock into grooves in the wheels on the outside, and have retaining rings on the inside, a practice which it would be well for us to imitate more than we do.

The tender and engine truck wheels are of the Mansel wooden disc pattern, 43½ inches in diameter. This form of wheel is very extensively used in England, but has never met with favor here. Some years ago they were tried on the Erie road and, we believe, some other lines, but failed. Why is it, it may again be asked, that these wheels are so satisfactory in England but fail here?

From our engraving it will be noticed that the truck axles have outside bearings. This would be impracticable if the cylinders were outside, and as outside bearings certainly have advantages over those inside, this feature may be counted in favor of the inside cylinders. The truck center-pin has a semi-lateral movement which is controlled by spiral springs, and the center-pin has a spherical bearing which permits perfectly free adjustment to lateral or longitudinal inequalities of the road, which cannot be said of our engines, which rest on broad, flat bearings on the trucks.

The exhaust pipe extends from the steam chests—which it will be remembered are below the cylinders—upward between them to a point level with the top row of tubes. This pipe has a division in it which extends from the steam chests to the top of the fifth row of tubes, counted from the bottom, and has a single large nozzle at the top. This arrangement thus seems to have the advantages of both the single and the double nozzles. The chimney projects downward inside the smokebox to a point about half way from its top to the upper row of flues, and has a flaring mouth at its lower end.

Another noteworthy feature is the fact that the engine has two pumps, which are worked from the crossheads, and apparently no injector. It would be interesting to know what led to this reversion to pumps on this line.

The sand-boxes, it will be seen, are placed over the frames, which makes them more accessible and removes them from a position where they obstruct the view and are certainly not ornaments.

A feature of this engine to which the attention of our locomotive superintendents and builders is especially directed is the steps which are provided on the engine and tender. There are, in the first place, two sets of steps, one on the engine and the other on the tender, which are alike and are on the same level. The lower ones are of liberal length and width, and have high flanges on the ends to prevent a person's foot from slipping off. In getttng on or off the engine one foot can be securely placed on one step and there is then a place for the other immediately alongside of it. On many American engines the steps are of such a form and size that it is not easy to find them nor to secure a foothold, and they are often not arranged in pairs, so that when the right foot is in place the position for the left one is not obvious. Between the engine and tender the steps are arranged in pairs horizontally and also vertically, or one above the other and with a plate back of them to prevent those mounting the engine from thrusting their feet inward. It should be noticed, too, that the same kind of steps are provided at the back end of the tender, and also between the main driving and truck wheels. These are all alike and on the same level, and for that reason anyone is less likely to make a misstep than they would be when the form, position and size of the different steps are unlike. In this respect this English practice is better, more intelligent and more humane than ours. The number of men who are killed and injured annually from falling off engines and cars is very large. Certainly it is the duty of all who have control of such matters to diminish the risks. Old Ross Winans was in the habit of advising his apprentices in this wise: "Boys," he would say, "if you must make a thing strong, make it d——n strong." It is not needful, perhaps, to imitate the old gentleman's forceful language, but it may be said that if you can make anything safe, then make it as safe as you can. The length and width and depth and location of these English steps certainly gives the men who must use them more security than they can have when what are called "pads" are used, to which Mr. Winans' adjective might properly be applied.

THE REVISED RULES OF INTERCHANGE.

The report of the committee of twenty-one appointed by the Master Car Builders' Association to revise and rearrange the rules of interchange on the lines suggested last year by the Southern and Southwestern Railway Club, has been issued and discussed by several of the railroad clubs. The report recommends a rearrangement of the rules under several headings such as "instructions to inspectors," "instructions to repair men," "instructions for billing" and "miscellaneous." The wording of the old rules has been retained in nearly every case but a few clauses have been introduced to make them conform to the spirit of the new interchange at Chicago, and an attempt has been made, but imperfectly carried out, to indicate responsibility for defects by statements after each section of the rules defining the defects for which cars may be refused.

The result of all this rearrangement is that while the code has gained somewhat in clearness it has lost none of its bulk, and yet such club discussions as we have read have been devoted almost wholly to the correction of sections that were not quite clear in the revision; in fact, nearly every one seems to have fallen in line and advocated the revision without at the same time insisting on condensation. This condition of affairs is much to be regretted, for now is the time to insist on greater simplicity. Delays to freight will not be reduced by simply reversing the phraseology of the rules so that instead of reading that "cars may be refused" for certain defects, they will read that "cars must be accepted" unless certain defects exist; what is wanted, rather, is as simple a code as can be devised on the principle of owner's responsibility. The words of Mr. John McKenzie before the New York Railroad Club should be carefully read by every official that has a vote in the Master Car Builders' Association. He said:

"It seems to me that the code of rules proposed by the Committee of Twenty-one goes as far as possible in the line of getting us deeper into a rut that we have been traveling in for the last ten years, by conglomerating and mixing up a lot of rules that do not assist the object that we have before us—that is, the smooth and equitable interchange of cars. The time has gone past when we can get together and say that you may receive a car, if you want to, and every place where the word "may" is introduced in this code of rules, the word "shall" ought to be introduced. Cars can be moved and they can earn money instead of waiting for somebody to make up his mind as to whether they shall put an I O U on the car or not; and it lies with us whether we shall change the rules, and make them so simple and so positive in their operation, that the cars must move, rather than have them stand on the side tracks until a few men who are able to earn a dollar and a half a day shall wrangle and decide whether the car shall move or not. The transportation departments of this country have come to the conclusion that a smooth interchange can be introduced. The Chicago agreement has shown that it can be done. The mileage of the cars has been increased a very large percentage, and the time has come when we must either do something or they will take it out of our hands and let somebody else do it. The transportation departments are ready to-day to take hold and make an interchange that will move the cars of the country.

"There is no question in my mind that all this business of going through the multiplication table, adding to and taking from, going from 1 to 84, and then going through the alphabet six or seven times from a to z, illustrating all these rules and the interpretation thereof—all this has gone by. We must stop it. What we want to say is that cars shall be offered in a serviceable condition, and they shall be accepted. Make the owners responsible for the defects that follow under fair usage. Under the Chicago agreement we undertake, with about 13 different paragraphs, to cover the entire code of rules, and everything is working smoothly."

A fact which has an important bearing upon this whole business of revision is that the entire Pennsylvania system has gone into the Chicago agreement. This is another way of saying that at the June convention the new interchange will receive the votes of that system and tha unless others who supported it last year change their votes it will be adopted this year. With this in prospect there should be a greater condensation of the rules than has thus far been proposed.

The present revision says (section 43) that "owners are responsible for failure under fair usage of any part of the body of the car," and (section 40) that "all defective or missing or worn out parts not already mentioned, which have failed under fair usage (are) chargeable to owners." Now if this is the case why should all of the sections relating to brake gear be retained? If a brake wheel is defective the owner can be billed for a new one without it being specifically mentioned in the rules. It would seem as if most of sections 18 to 39 could be omitted. The elaborately defined and illustrated defects of couplers can also, in the opinion of many practical men, be omitted. It ought to be possible to omit section 52, which says that "locks, grain doors and inside parts of cars are at owners risk, except where damaged by wreck or unfair usage," if section 43, above quoted, means what it says.

There are also some things in the rules the absurdity of which is not appreciated because of long familiarity with them. For instance we are told that cars can be refused if the axles are bent or broken or the collars worn off! Or if a wheel under the car is burst or is loose on the axle! Such rules ought not to be required in this generation, and if they are needed it is a severe comment upon the manner in which interchange is now handled, and is to be handled under the new agreement.

From the discussions on interchange rules one would think that nearly the entire cost of car repairs was involved, but as an actual fact the percentage is quite small. One of the largest systems in the country can show by its accounts that the repairs to its own cars made by foreign roads amounts to but 1.5 per cent. of the total cost of the repairs to its cars and of several other large roads whose figures we have seen none show more than 3 per cent. Though this small per cent. runs into the tens of thousands of dollars any lack of equity in the items composing it are so largely offset by similar bills against other roads, that probably the most ardent advocate of rigid rules cannot show that the least equitable of the rules ever put in force by the association added one-half of one per cent. to the total cost of car repairs through work done on defect cards or in interchange, except as they have compelled the making of unnecessary repairs by the owing road. With such a small percentage of the total cost of car repairs involved in the repairs which foreign roads are empowered to make on the cars of any road, and with a saving in prospect from the reduction in the amount of unnecessary repairs and the avoidance of delays in interchange, it behooves the members of the Master Car Builders' Association to so frame the new rules as to get the full benefit of the change, and to show by such action that are really actuated by that broader spirit of which the adoption of the Chicago interchange is supposed to be indicative.

"Industry."

Those persons whose good fortune it has been to have had the acquaintance with and knowledge of a monthly magazine published in San Francisco and edited by John Richards will regret to hear that its publication will probably be discontinued after January, 1896. In that number the following announcement was published:

"The present publishers of *Industry* will not issue the magazine longer. If a new management assumes the business, proper announcement will be made to its patrons and clients. Five thousand pages of matter, nearly all originally written, have been furnished to our readers in good faith, in candor, and continuous effort toward honesty and truth, but the work is, and has been for several years past, more than their powers permitted, or the patronage of the journal warranted.

"During eight years of publication there has been a great change in the conditions under which a technical journal must be conducted on this coast in order to secure the commercial patronage required to sustain it. The methods are neither congenial to nor consistent with an independent technical publication devoted to matter such as has appeared in *Industry*, nor with the policy first assumed and continually carried out, that of laying before readers useful truths that would promote their interests and business.

"The present issue has been delayed by the illness and absence of the editor. It closes his and the publisher's labors, and it remains to thank many warm friends who have encouraged and promoted *Industry*."

There is a pathetic tone about this, which will perhaps express the feelings of other editors as well as those of the

author of what is in reality a valedictory, or the antonym of an announcement. *Industry* has been one of the most delightful publications that reached our pile of exchanges. It came each month with the fresh characteristics which were infused into it by the original work of its editor. Unlike most other publications, its contents consisted largely of matter written by him, who each month gave his readers the most interesting and instructive comments on current engineering subjects. Research need not be carried very far among his contemporaries to find others to whom the methods and conditions which must now be adopted or complied with "to secure commercial patronage are not congenial" nor appear to be consistent with independent technical journalism. Whether it was this reason or that of ill-health—vaguely hinted at—which has led the author of the charming articles in *Industry* to abandon the editorial field, it will in either event be much regretted by those who know him or his publications, and still more by those who know them both.

The South-west Railway Record and Engineering News.

We are in receipt of a copy of No. 6 of this—to us—new publication, issued in Kansas City, with a request to exchange which will be cheerfully acceded to. The paper is neatly printed, and has a sort of an enterprising and "hustling" tone about it which is indicative of its Western habitat. As will be seen, it has adopted as its sub-title that of one of our New York contemporaries. This appropriation is, however, regarded in this office with equanimity, for the reason that the journal which has thus been despoiled of its good (?) name was guilty of a similar act some years ago in adopting "*Railway Journal*" as its sub-title, which is substantially the name under which this paper had been published for over 50 years, and which is still retained. The court refused to right the wrong, and our friends in Kansas City can now appeal to its decision, if they are disturbed in the possession of that which our sense of integrity compels us to admit is not fairly theirs, any more than *Engineering News* of New York is entitled to use *Railway Journal* as part of its title.

Notes.

Many of the cases submitted to the Arbitration Committee of the M. C. B. Association for settlement are so simple that it is a matter of surprise that they were ever presented to that body, but in the latest report of the committee there is a case of considerable importance. It is Number 323 and is between the C., C., C. & St. L. and the Terre Haute & Indianapolis railways. In July, 1895, an elevator located on a siding connecting with the T. H. & I. Ry., was destroyed by fire, and several cars burned, among them two C., C., C. & St. L. cars. The latter road has a contract with the T. H. & I. Ry., by which its cars are delivered on this siding to be loaded and re-delivered to the C., C., C. & St. L. Ry., for a switching charge of $1.50 per car paid to the T. H. & I. Ry. In the case of the two cars burned, it happened that the C., C., C. & St. L. train crew with their own engine switched the cars over the other company's tracks and onto the siding, because there was no T. H. & I. crew on hand at the time to do the work. The switching charge was paid, of course, just the same as though the switching had been done by the other road. The T. H. & I. Ry. claimed that it did not deliver the cars onto the siding as per rule 28, while the C., C., C. & St. L. Ry. claims that in doing the switching it was only acting for the other road, and that the road owning the tracks connecting to the siding is and is the only party that can be expected to have a contract with parties owning the siding covering loss by fire. The Arbitration Committee decided in favor of the C., C., C. &. St. L. Ry., saying: "If the owners of the track had actually made the delivery there would not, under the rules, have been any room for dispute, nor is it believed that the fact of another road having attended to the work for the track owner and having paid them for it alters the case."

A compound engine of 10 horse power and weighing, with its pumps, 185 pounds, was recently exhibited in England. It was built for a launch and makes 600 revolutions per minute with a steam pressure of 250 pounds.

At the Lake Shore shops at Englewood, Chicago, Mr. T. Fildes bends air-brake train pipes on the bulldozer. The pipes are first cut to proper lengths and then bent by the use of suitable dies. After a large number of pipes are bent and stacked up, a man turns a steam jet into each pipe, thus removing any scale or dirt that may be in them.

The *Railway World* is authority for the statement that on the London & South Western Railway the oil lanterns carried by ticket collectors and by the light of which they were enabled to decipher passengers' tickets, have been superseded by small electric lamps, which are fixed on the overcoats of the collectors and supplied with current by a small accumulator carried in the breast pocket. A month's experiment is to determine whether the innovation is an improvement, and if the officials find it such, the electric lamps will be generally adopted. It is said that on several omnibus lines similar apparatus have proved a convenience greatly appreciated by conductors.

A $200,000 steel steam yacht for Mr. P. A. B. Widener, of Philadelphia, is under construction at the Crescent shipyard, Elizabethport, N. J. It is 225 feet long, 183 feet long on the water line, 28 feet beam, and draws 11 feet 6 inches of water. The displacement is 800 tons. There is a steel house on deck 135 feet long and 18 feet wide, over which is a promenade deck. The engines are to be triple expansion, with cylinders 18, 27 and 42 inches in diameter and 28 inches stroke. Two Scotch boilers will furnish steam at 175 pounds pressure, and it is expected that 1,250 horse power will be developed. The capacity of the coal bunkers is 210 tons. An electric lighting plant and a refrigerating plant will be installed. The furnishings will be costly, and when completed the owner intends taking his family in it for a trip around the world.

The use of liquid fuel has been so extended on the Great Eastern Railway (England) that a large storage plant has been erected at Stratford. Twenty-five locomotives are now fitted with oil burners under the Holden system, and 12 stationary boilers and three furnaces at the shops burn the same kind of fuel. The oil arrives at Stratford in bulk, old locomotive tenders being employed in transporting it at present. The storage tanks are 13 in number and are placed on low ground not very far from the main line. The oil flows to them by gravity. A peculiarity of the tanks is their rectangular shape. Nine of them hold 3,000 gallons each and the remaining four 2,500 gallons each, making a total of 37,000 gallons storage. From these tanks oil is pumped to an elevated tank of 4,000 gallons capacity (also rectangular) from which it is taken for consumption. Locomotives burning 35.4 pounds of coal per mile perform equal duty upon 16.5 pounds of oil per mile, and if the fuels are mixed the engines will average 11.8 pounds of coal and 10.5 pounds of oil per mile.

A committee of the Association of American Steel Manufacturers has asked the Board of Supervising Inspectors of Steam Vessels at Washington to amend the present specifications for steel boiler plate by striking out Section 13 relating to test pieces, and putting in their place four paragraphs which specify that steel for marine boiler plates must be made by the open-hearth process, and be of domestic manufacture; that the test pieces used to ascertain its strength shall be 1 inch wide at the reduced section, and 9 inches long with 2-inch radii connecting the reduced section with the ends, and that said ends shall be 1¼ to 2 inches wide and from 4 to 6 inches long· that before placing the test piece in the machine punch marks shall be placed at intervals of 1 inch, and the length in which the elongation is measured shall be taken as nearly equally as possible on both sides of the fracture; in plates less than ¼ inch in thickness this length shall be 2 inches; in plates ¼ inch thick and up to ⅜ inch it shall be 4 inches; in plates from ⅜ inch to 1 inch inclusive it shall be 8 inches, and in plates over 1 inch it shall be 6 inches. It is also suggested that the maximum figure which can be stamped upon the steel as indicating its tensile strength shall be 60,000 pounds per square inch, and the factor of safety in all cases shall be five. The committee also recommend that the board place a limit upon the amount of phosphorus and sulphur allowable in plates, as under the present rules of the Board it is possible for a manufacturer to use a metal for boilers which would not be accepted by the majority of engineers for the most unimportant work, and it is considered certain that such a clause would be a long step in the direction of a much better and safer metal, while it would not materially enhance the cost. As to the limit of 60,000 pounds for tensile strength, the committee say that under the present law there is nothing to prevent a boiler maker from ordering steel with a tensile strength of 70,000 pounds, or even 80,000 pounds, per square inch, and using a proportionately high steam pressure. This material is considered dangerous by the manufacturers. In asking that the factor of safety be made five, it is claimed that while the factor is now nominally six, it is based upon the strength as exhibited by a grooved test piece, which always gives results higher than the actual strength, and by making the factor five and basing it upon the strength as derived from a parallel-sided test piece the actual factor of safety is the same as in the past.

A test of steam pipe coverings was recently conducted under the auspices of the Boston Manufacturers' Mutual Fire Insurance Company, by C. L. Norton, the results of which are given in the following table, in which the losses are expressed in ratios, that from a bare pipe under 200 pounds pressure being given as unity:

200 pounds steam pressure.	Loss.	10 pounds steam pressure.	Loss.
Nonpariel cork	0.254	Nonpariel cork	0.232
Magnesia	0.281	Air cell 2	0.261
Air cell 2	0.284	Magnesia	0.262
Air cell 1	0.300	Magnabestos	0.383
Magnabestos	0.321	Fire felt	0.395
Fire felt	0.333		
Calcite	0.423		
Bare pipe	1.000		

The method of making the test was novel. A piece of double thick steam pipe four inches in diameter was filled with oil and a suitable stirring apparatus inserted through the upper end, the pipe occupying an upright position. A coil of wire was also immersed in the oil and connected to an outside circuit. A thermometer, voltmeter and ammeter completed the apparatus. By turning on an electric current until the heating coil raised the oil to the required temperature and then regulating the current until the temperature was maintained exactly, the heat furnished by the current was evidently equal to that lost by the pipe, and could be calculated from the current readings. The materials tested were applied to the outside of the cylindrical part of the pipe, the ends being protected by the same blocks of calcite, four inches thick, throughout all the tests. The thicknesses of the protecting materials are not given.

The Brooklyn & New York Ferry Company, which operates the Grand Street Ferry, has contracted with John B. Roach for two more ferryboats similar to the three recently built for them at the same yards. The new boats will be built of iron instead of steel, the latter material being considered better calculated to resist the action of the acids and other corrosive materials poured into the East River from the sewers of New York and Brooklyn. They will be double-deckers, 168 feet long, 36 feet 6 inches moulded beam, 62 feet over the guards and 14 feet 6 inches depth amidships. They will be driven by condensing engines and have single boilers 10 feet 6 inches in diameter and 28 feet long. The wheels will be 19 feet 6 inches in diameter. The boats will be supplied with gas and electric light plants and steam steering apparatus, and will be handsomely finished throughout.

Figures compiled by the Glasgow *Herald* show that there has been a steady decrease since in 1891 in the number of men employed in the locomotive building industry of Great Britain. In 1891 the number of men engaged in this line of work was 11,803; in 1892, 9,971; in 1893, 9,043; in 1894, 8,251, and in 1895, 8,473. Part of this falling off is accounted for by the smaller export business, other countries doing more of the building for themselves.

Underfeed stoking, which means that the fuel is fed upward beneath the fire, instead of placed on top, is an extremely common-sense method if considered in the abstract. In the concrete it involves apparatus that is not a desirable adjunct to a steam furnace, also involves artificial or forced draught, but even on those conditions there is strong probability of survival of the system.

There is a conflict of conditions or principles in this matter of heating furnaces that it will be hard to reconcile. If the draught is upward, and the fresh fuel fed on top, the combustion is wrong-end foremost and smoke unavoidable. If downward, the fuel sustaining part, the grates, are burned out; horizontally a draught through a deep stratum of the fuel is impossible.

The subject has come with increasing interest during ten years past, and while there has been no distinct invention or method that can be called satisfactory, it is a good deal to have gained the admission that improvement must be made.

Some years ago, when in Portland, Ore., we came across a steam furnace burning wood for fuel, the supply being forced through a tube under the grates. The impression at the time was, that here was a scheme that might possibly find wide extension in future, and the subject is again brought to mind by a circular received from the Jagoda Furnace Company, of Portland, Ore., relating to underfeeding furnaces, with tabulated results from various places where their system has been applied.

As now arranged a steam piston is employed to push in at intervals a charge of fresh coal beneath the fire, air being supplied by means of fans.

The Edison Electric Light and Power Company, of this city (San Francisco), have equipped their new boilers with this apparatus for underfiring; so also the Omnibus Cable Railway, and as these large plants are under the care of able and conservative engineers, there is no doubt of the practical working and economy of the system.

It is a fertile field for invention, this fuel burning, and it seems strange to see a struggle after a few per cent. of increased efficiency in steam engines when ten times as much can be, and is, lost or saved by methods of firing.—*Industries.*

Trade Catalogues.

[In 1894 the Master Car-Builders' Association, for convenience in the filing and preservation of pamphlets, catalogues, specifications, etc., adopted a number of standard sizes. These are given here in order that the size of the publications of this kind, which are noticed under this head, may be compared with the standards, and it may be known whether they conform thereto.

It seems very desirable that all trade catalogues published should conform to the standard sizes adopted by the Master Car-Builders' Association, and therefore in noticing catalogues hereafter it will be stated in brackets whether they are or are not of one of the standard sizes.]

STANDARDS.

For postal-card circulars	3¾ inches by 6¼ inches.
Pamphlets and trade catalogues	3½ inches by 6 inches. 6 inches by 9 inches. 9 inches by 12 inches.
Specifications and letter-paper	8¼ inches by 10¾ inches.

Catalogue of Locomotives. Cooke Locomotive and Machine Company. Paterson, New Jersey: 1895. 71 pages, 6 by 9 inches. (Standard size.)

This old established company, in conformity with the practice of other establishments, has issued a "catalogue" which is a good deal more than its name implies. It is in fact to some extent a history of its founder, and of the company of which he was the head, and the works which he originated, and it then describes the products of that establishment.

The frontispiece is a portrait showing the genial and

kindly face, which some of us older numbers can recall with so much pleasure. It gives a brief biography of him, and states a fact which is probably not generally known, which is, that he was a native of Montreal.

Views of the works in 1853, 1882 and 1895 are given with a historical sketch of their origin and development. The present establishment and its facilities for doing work are then described, with views of the office, the inside of the machine shop, the erecting and boiler departments and the hydraulic flanging press, with samples of the work done on it. A view of the inside of the foundry and the transfer table with a rotary snow-plow—manufactured by this company—on it, are also shown. A view is also given of a 40-foot water-wheel, which is also one of the products of these shops. This is followed by a general description or blank specification of a locomotive.

The second part of the book has the title "General Description of Some of the Locomotives Built by the Cooke Locomotive and Machine Company," and gives a series of views—half tone engravings—of eleven different kinds of eight wheeled or American type of engines, eleven ten-wheelers, seven "Moguls," five "Consolidations," four diagrammatic views of the latter class, four half tone engravings of six-wheeled switching engines and six diagrammatic views of four-wheeled "switchers." The book ends with tables giving the dimensions of the different engines built by the company. The catalogue is printed on heavy paper, and on one side of each leaf only, so that it is larger than the number of pages would indicate.

We are inclined to question the propriety of this. In these days of multiplicity of literature, economy of space should be aimed at. It would be a distinct advantage if this—and other catalogues—occupied only half as much space as they now do on our bookshelves, and the mere bulk of a book is often a reason why it is not preserved. The printing, paper and binding are all admirable, but some of the illustrations are hardly up to the highest standards of excellence of to-day. If catalogue makers would only know how much a coat of dull, lead colored paint, on the objects photographed, would improve their pictures, they would have much better illustrations than they now have. If, for example, the hydraulic flanges illustrated in the book before us had been painted in that way before being photographed, the pictures of it would have been immensely improved. It may also be suggested that the attendants, shown in their positions, ought also to have had a coat of some kind of paint before their portraits were taken, so that they would look a little less like New Jersey politicians than they now do. The catalogue is in excellent taste, and serves its purpose of making known the kind and character of work done in this establishment. A supplementary notice pasted in it announces that Messrs. Bryan & McKibbin, of 120 Broadway, New York, have become the general sales agents of the company.

CHAIN BLOCKS. *The Yale & Town Manufacturing Company.* 44 pages, 6¼ by 8 inches. (Not standard size.)

CASE'S IMPROVED PROPELLER WHEELS. A. Wells Case, Highland Park, Conn.; 41 pages, 5¼ by 7½ inches. (Not standard size.)

BEAMAN & SMITH, Providence, R. I., designers and makers of machinery and tools. Catalogue D. 64 pages, 3¼ by 5¼ inches. (Not standard size.)

The class of tools illustrated in this catalogue and which is manufactured by this firm includes chiefly milling, drilling and boring machines, with a few lathes of standard type. Some 25 different patterns of tools are illustrated and described. They are represented by very good wood engravings, printed on a light green ground. The latter feature does not seem to be a happy invention, although the character of the machines is clearly shown and the descriptions are full and satisfactory.

SOMETHING ABOUT WESTINGHOUSE ENGINES. 12 pages, 3¼ by 5¼ inches. (Not standard size.)

The purpose of this little pamphlet is to describe the thoroughness with which this company tests its finished engines before they are sent away from the shop. To this end views are given of their engine testing room, and another of the surface condenser, and weighing tanks employed. The methods of testing are described, and the objects arrived at are set forth.

TOBIN BRONZE. The Ansonia Brass and Copper Company, Manufacturers, New York. 36 pages, 3¼ by 5¼ inches. (Not standard size.)

DIAMOND GRINDING MACHINERY FOR ALL METALS, CATALOGUE No. 15. Diamond Machine Company, Providence, R. I. 64 pages, 5¼ by 9 inches. (Not quite standard size.)

From this catalogue the reader can get some idea of the variety of purposes for which emery wheels are used, which are indicated by the number of different kinds of grinding machines which this company makes. Over 50 different machines are here illustrated by good wood engravings with brief descriptions and statements of the uses for which the machines are intended. Any mechanic will be sure to get some new idea of methods of doing work, by looking through this book and becoming acquainted with the special machines which are made for special work.

The publishers evidently intended it to be of standard size, 6 by 9 inches, but the binder trimmed it to 5¼ inches. We have often wondered that cases of homicide of bookbinders is not more common. With the most careful instruction about trimming books, they will often spoil them by cutting away the margin, apparently out of pure cussedness.

WIRE ROPE TRANSMISSION IN ALL ITS BRANCHES. The Trenton Iron Company, Trenton, N. J. Cooper, Hewett & Co. New York. 68 pages, 5¼ by 8 inches. (Not standard size.)

This is what may be called a trade treatise, but as it bears the imprint of 1892, is apparently an old publication with new covers, and therefore hardly demands extended notice. The title page says it relates to Wire Rope Tramways, with special reference to the "Bleichert" and "Acme" Patent Systems; also, Single-Rope Tramways, Patent Cableways, for Quarries, Open Cut Work, Ferries, etc. Wire Rope Outfits for Shafts, Inclined Planes, Underground Haulage Plants, etc., and Power Transmissions. It is illustrated with many engravings showing views and details of wire rope "plants." Some of these illustrations are excellent, but others cannot be highly commended. Altogether, though, it is an admirable publication and is an indication that in the future every trade catalogue will be an elementary treatise on the art to which it relates.

Personal.

Mr. E. M. Dickey has resigned as President of the Hot Springs railroad.

E. S. Jemison, President of the Houston, East & West Texas, died last month.

Mr. H. M. Comer has been elected President of the Central Railroad of Georgia.

Mr. William Davis, President of the San Antonio & Gulf Shore Railway has resigned.

Mr. Dwight M. Philbin, General Manager of the Duluth, Missabe & Northern Road, has resigned.

Mr. M. V. Meredith has been appointed General Manager of the South Haven & Eastern Railway.

Mr. W. H. Young has been appointed Master Mechanic of the Southern Railway at Sanford, Fla.

Mr. Stanley E. Russell, representative of the Q. & C. Company at Atlantic, Ga., died on Feb. 13.

Mr. T. R. Foster has accepted the position of Mechanical Engineer on the Denver & Rio Grande, at Denver, Colo.

Mr. Geo. Thompson has been appointed Master Mechanic of the Beach Creek road, vice Mr. La Mott Ames, resigned.

Col. W. P. Thompson, President of the Ohio River Railroad, died suddenly of pneumonia in New York City, on Feb. 3.

Mr. T. C. Sherwood has been appointed General Manager of the Kansas City, Pittsburgh & Gulf Railway with office at Kansas City.

Mr. F. G. Wheeler has been appointed Purchasing Agent of the Oregon Railway and Navigation Company, with office at Portland, Ore.

Mr. W. J. McLean has been appointed Master Mechanic of the Third Division of the Plant System, with headquarters at Montgomery, Ala.

Mr. Albert G. Blair, who has been General Manager of the Wheeling & Lake Erie since 1892, has been chosen President, to succeed Mr. F. R. Lawrence.

Mr. John H. Winder, General Manager of the Seaboard Air Line, has retired from that office, and its duties will be combined with those of the vice-presidency.

Mr. A. D. Ward has been appointed Purchasing Agent of the Chicago Great Western, with headquarters at St. Paul, Minn., in place of Mr. John Warwick, resigned.

Mr. J. Forster, Assistant Master Mechanic of the Atchison Topeka & Santa Fe at Argentine, Kan., has been appointed Master Mechanic of that road at La Junta, Colo.

Mr. C. H. Hudson, Chief Engineer of the Southern Railway, has also been appointed Mechanical Engineer of that road, with advisory duties in the motive power department.

Mr. James McCrea, First Vice-President of the Pennsylvania lines west of Pittsburgh, has also been chosen president of the Terra Haute & Indianapolis, to succeed Mr. W. R. McKeen.

Mr. Edwin C. Hiser, Master Mechanic of the New York Central & Hudson River, the Rome, Watertown & Ogdensburg, and the Adirondack & St. Lawrence, with office at Utica, has resigned.

On account of bad health, Mr. J. D. Campbell has resigned the position of Master Mechanic of the Buffalo & Susquehanna Railroad to take effect upon the appointment of his successor.

Mr. C. M. Lawler has resigned the position of General Manager of the Philadelphia, Reading & New England Railroad, and Mr. W. J. Martin, formerly General Freight and Passenger Agent, succeeds him.

Norman J. Paradise, General Master Mechanic of the Hannibal & St. Joseph, and St. Louis, Keokuk & Northwestern, died at his home in Hannibal, Mo., in January. He had been with the Burlington system since 1859.

Mr. J. B. Swann, General Foreman of car repairs of the Pittsburgh division of the Pennsylvania lines at Dennison, O., has been transferred to Columbus, O., as General Foreman of Car Repairs, to succeed Mr. John Commerford, resigned.

Mr. John H. Orchard has been appointed Master Car Builder of the Pennsylvania Division of the Delaware & Hudson Canal Company, and of the Gravity Railroad with headquarters at Carbondale, vice Mr. Thomas Orchard, deceased.

Mr. E. M. Roberts has been appointed Master Mechanic of the Southern Iron Car Line, with office at Atlanta, Ga. Mr. Roberts was Superintendent of Motive Power of the South Carolina Railway for some years, but resigned that position in 1894.

Mr. Willard Kells, son of the late Ross Kells, has been appointed Master Mechanic of the Erie shops at Cleveland, O. Mr. Geo. Donahue, who formerly occupied the position, has been transferred to Meadville, Pa., to succeed Mr. F. B. Smith, resigned.

Mr. W. R. Setchel has been appointed Master Mechanic of the Wheeling & Lake Erie Railroad, to succeed Mr. O. P. Dunbar, with headquarters at Norwalk, O. Mr. Setchel is the son of Mr. J. H. Setchel, General Agent of the Pittsburgh Locomotive & Car Works.

Mr. F. W. Brazier, formerly Superintendent of the Chicago, New York & Boston Refrigerator Company, and located at Elsdon, Ill., has been appointed General Foreman of the Car Department of the Illinois Central Railroad and will have charge of all car work at the new Burnside shops of the company.

Mr. W. J. Spicer, General Manager of the Chicago & Grand Trunk, the Detroit, Grand Haven & Milwaukee, and other Grand Trunk roads west of the Detroit River, has resigned, after 12 years of service in that position. The duties of the office will be performed by the General Manager of the Grand Trunk at Montreal.

Mr. Arthur M. Parent has been appointed Manager of the Pullman Works of the Pullman Palace Car Company, to succeed Mr. Harvey Middleton, who resigned in January. Mr. Middleton was with the company since 1891, previous to which he had occupied prominent positions in the railroad service, among which were the positions of Superintendent of Motor Power on the Union Pacific, on the Atchison, Topeka & Santa Fe and on the Louisville & Nashville.

Mr. R. D. Wade has resigned from the position of Superintendent of Motive Power of the Southern Railway, and Mr. W. H. Thomas has been appointed his successor. Mr. Wade began his railroad career in 1857, and since that date has been on Southern roads and chiefly on lines now in the control of the Southern Railway. Mr. Thomas was Superintendent of Motive Power of the East Tennessee, Virginia & Georgia before it was absorbed by the Southern Railway.

Mr. John K. Cowen, formerly General Counsel for the Baltimore & Ohio Railroad, has been elected President of the road. Vice-President Orlando Smith has resigned, and his place has been filled by the appointment of Mr. Oscar G. Murray, formerly Second Vice-President of the Big Four. Mr. Smith retains the Presidency of the Baltimore & Ohio & Chicago Railroad, the Pittsburg & Connellsville Company, and the Parkersburg Branch Railroad Company, and other branch lines of the Baltimore & Ohio. Second Vice-President T. M. King has also resigned, and has accepted the Presidency of the Baltimore & Ohio Southwestern.

Mr. C. C. Waite, President of the Columbus, Hocking Valley & Toledo Railway, and who for more than a week had been ill of pneumonia in his private car at Columbus, O., died on Feb. 21. Mr. Waite entered railroad service in 1864, and became Chief Engineer of the Cincinnati & Muskingum Valley in 1869, with which road he remained until 1881. For one year he was assistant to the President of the New York, Lake Erie and Western, and from 1882 to 1889 he held the position of Vice-President of the Cincinnati, Hamilton & Dayton. In 1889 he was made President of the Hocking Valley, which position he held at the time of his death.

Mr. F. D. Adams has resigned the position of Master Car Builder of the Boston & Albany Railroad, on account of advanced age. He was born Aug. 30, 1822. He began car work in 1847 and entered railway service in 1859. From 1859 to 1868 he was Master Car Builder of the Buffalo & Lake Erie Railroad, now a part of the Lake Shore & Michigan Southern, and for the next two years was Superintendent of the Ohio Falls Car Company. In 1870 he was appointed to the position he has just resigned. He has always been active in association and club work, and was one of the founders of the Master Car Builders' Association. Though retired from active service, his many friends will be pleased to again meet him at the conventions of this Association, in which he has been such a familiar figure.

Box Car of 60,000 Pounds Capacity with Steel Sills —Chicago, Burlington & Quincy Railroad.

The box car of 60,000 pounds' capacity that has been standard on the Chicago, Burlington & Quincy Railroad for several years past has the draft rigging on the center sills, the drawbar stem passing through the end-sill. This construction, combined with an excellent draft gear, gave perfect satisfaction. But the mechanical department believes that some day dead-blocks will be used in conjunction with M. C. B. couplers, and to apply dead-blocks to cars with draft gears between the sills would require them to be above the plane of the floor sills. For this reason the standard design was modified recently, and the floor of the car raised with reference to the coupler and draft gear.

In making the change it was decided to keep the draft gear on the center sills as heretofore, and consequently these sills were placed six inches lower than the intermediate and side sills, and filling blocks or timbers extending the whole length of the car were fitted between them and the floor. This requires about the same amount of material as where ordinary draft timbers are employed and filling pieces under the sills are employed to make them practically continuous for the length of the car, but the single and more substantial piece of timber is in this case placed in the direct line of thrust from the draft and gear without impairing its utility as a floor beam.

The mechanical department then went a step further and built a sample car, in which the center sills are steel channels, as shown in the accompanying illustrations. They are placed in the same position as the wooden sills referred to above, except that their tops are only 5 inches below the floor because of the greater depth of the channels. The latter are 10 inches deep and weigh 25 pounds per foot. Fig. 1 contains cross-sections at the bolster and needle beam and shows clearly the arrangement of parts. The bolster is very deep, 16⅛ inches over all at the center, and its plates 10 inches wide. Castings between the center and intermediate sills strengthen the bolster and cause it to retain its strength and stiffness regardless of any shrinkage of the wood. Between the center sills a wrought iron strap of ¼-inch by 10-inch iron unites the parts, and outside of the intermediate sills a casting fills the space between the plates of the transom and takes the pressure of the side bearing. The construction at the needle-beam is clearly shown. The 2-inch timber between the intermediate and side sills only extends from one needle-beam to the other. Straps ¼ inches by 3 inches unite the center sills at each needle-beam.

One thing is noticeable from Fig. 3 and that is the absence of bolts or rivets in the flanges of the channels. This has been done to avoid weakening them. From Fig. 2 it will be seen that between the ends of the center sills and the inside faces of the end sills a ½-inch plate is inserted and the channels are secured to it by angle iron brackets. A detail of one-half of the plate is given. This Fig. 2 also shows the draft gear, which has been such a success and which originated on this road. The stops are steel plates bent over double and are riveted to steel cheek plates, the ends of which are bent out to help retain the stops in place. The whole is riveted to the inside faces of the channel sills. The carrier irons are double and the dead wood is protected by a 4 by 4 by ½-inch angle iron, as shown.

This box car is probably the first one intended for regular service to be equipped with steel center sills, and marks another advance in the use of metal in car construction. The road has for some time used steel channels for the center sills of tender frames.

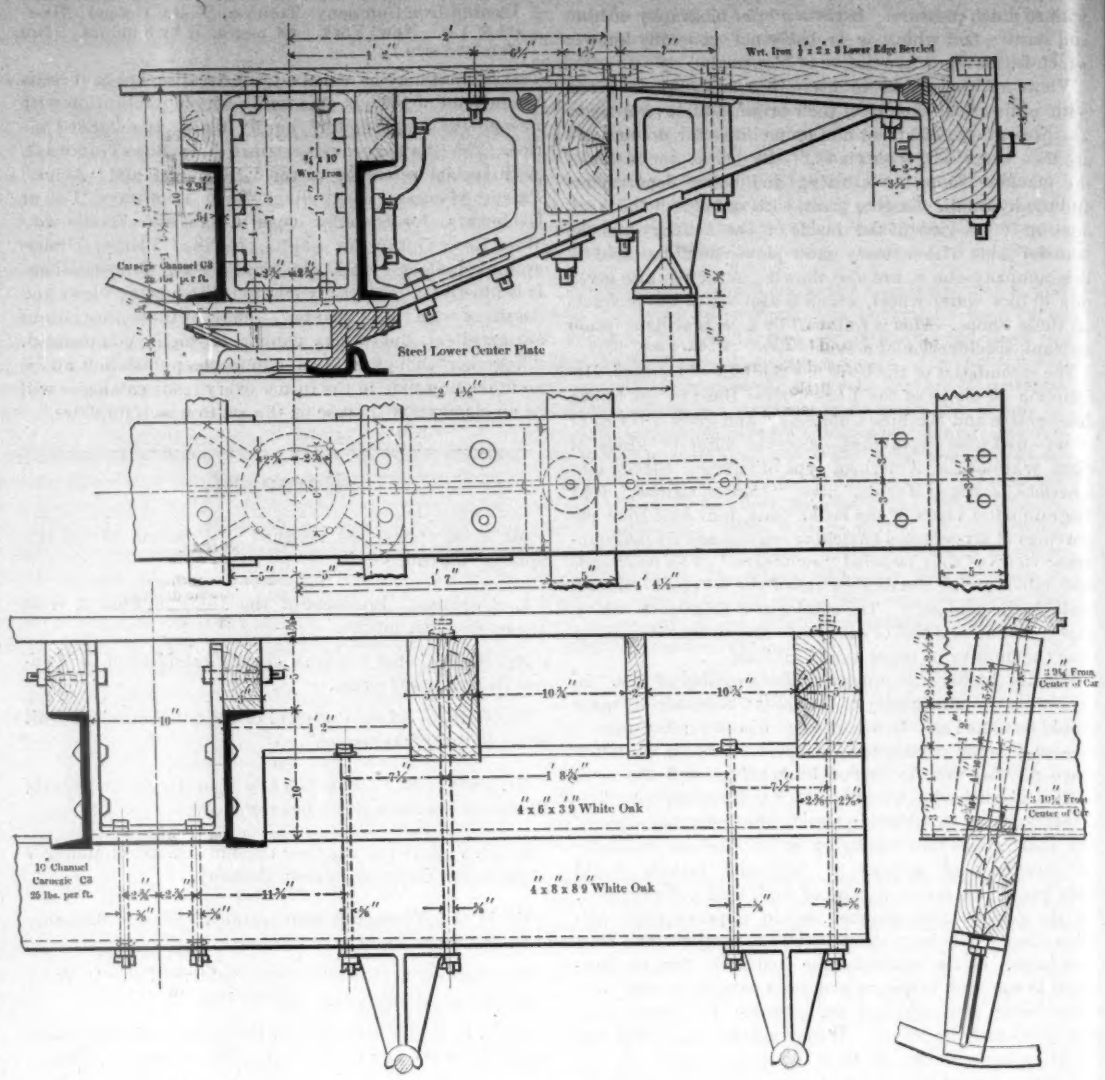

Wrt. Iron ½ x 2½ 8 Lower Edge Beveled
Steel Lower Center Plate
10" Channel Carnegie C3 25 lbs. per ft.
4 x 6 x 3 9 White Oak
4 x 8 x 8 9 White Oak
2.94 From Center of Car
3.10½ From Center of Car

Fig. 1.

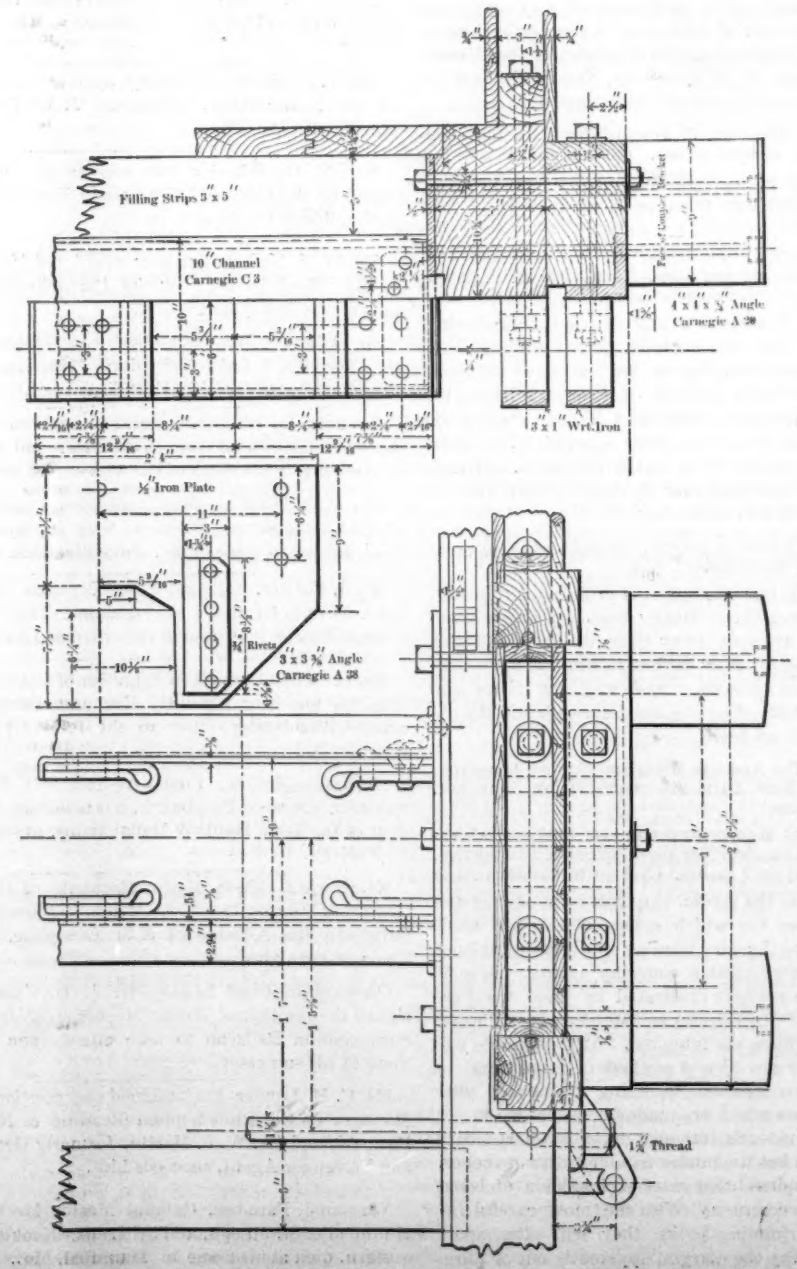

Filling Strips 3" x 5"
10" Channel Carnegie C 3
4" x 4" x ⅜" Angle Carnegie A 39
3" x 1" Wrt. Iron
½" Iron Plate
¾" Rivets
3" x 3 ⅜" Angle Carnegie A 38
1¼" Thread

Fig. 2.—Box Car of 60,000 Pounds Capacity with Steel Sills,—Chicago, Burlington & Quincy Railroad.

Daniel Kinnear Clark.

The death of Mr. Daniel Kinnear Clark severs another of those links with the railways of the past now all too few. Albeit he never carried out any great engineering work, he was a noteworthy man, and will not soon be forgotten. He died at his residence, 8 Buckingham street, Adelphi, on Jan. 22, aged 74. Of his early years and parentage little is known. We first hear of him as an apprentice in the Phœnix Iron Works, Glasgow. Subsequently he was an assistant to Mr. Miller, who had an extensive practice as a civil engineer in Edinburgh. Mr. Miller had a good deal to do with railways, and after young Clark had been with him for three years, he was appointed Locomotive Superintendent to the Great North of Scotland Railway. While there he was diligent in obtaining information on the performance of locomotives, consumption of fuel, train resistance, etc. For some reason, however, probably inherent in the man, he does not seem to have taken kindly to practical engineering. So long as experiments or investigations were to be carried out or conducted, he was happy; but the everyday routine duties of an engineer in a responsible position did not appear to suit him. He had a strong literary bent. In 1855 he published his book on the locomotive engine and the machinery of railways. Nothing so complete and altogether satisfactory had been published before; nothing equal to it has appeared since. To this moment Clark's book is a standard work of reference. Of course, the lapse of time has rendered much that it contains obsolete. Locomotives of much greater power than Clark dreamed of are running, but the fact remains that Clark made scarcely any mistakes.

The success of his book was so great that Mr. Clark left the Great North of Scotland Railway and started in business as consulting engineer in London. In 1857 he established himself in 8 Buckingham street, Adelphi, and there for

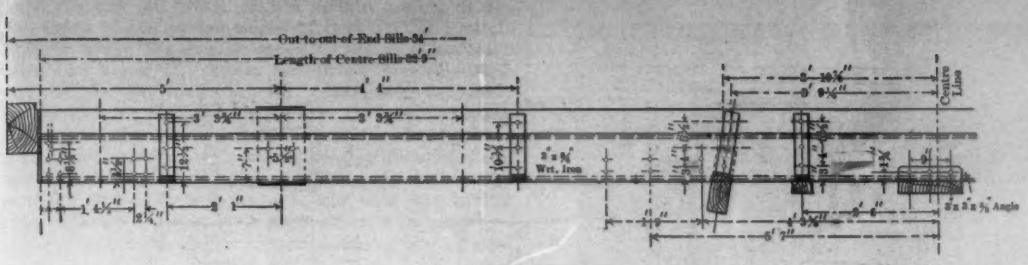


Fig. 3.—Steel Sill for Box Car.—C. B. & Q. R. R.

forty years he lived and worked. Of how few can a similar story of long residence be told? The fact bears testimony to the remarkable adhesiveness of the man. He had no desire to wander; he did curiously little to bring himself into notice, and yet where is the engineer of the last generation who did not know D. K. Clark either personally or by reputation.

In 1861 it became necessary to appoint an engineer to take charge of the machinery department of the International Exhibition of 1862. The choice devolved on Mr. Clark, and he carried out the work and discharged the duties with a skill and tact and an abscence of friction worthy of all praise. His employment at the exhibition just suited him, and he there conducted several experiments, the most noteworthy perhaps being a trial of centrifugal pumps. Then he wrote a book, "The Exhibited Machinery of 1862," which, if it did not add to his reputation, constituted a most useful volume for reference.

During the next few years we find him acting as judge for the Royal Agricultural Society and carrying out experiments, almost always in connection with steam or fuel. In connection with the Smoke Abatement Exhibition at South Kensington in 1881 he conducted an elaborate series of experiments and his treatise on the subject, embodying the results of his experiments, may be said to contain all that is known or worth knowing concerning the domestic consumption of fuel.

But before this, that is to say in 1877, he produced the book which will do more to keep his name alive than any other which he wrote; we refer to "A Manual of Rules, Tables and Data for Mechanical Engineers." Those who have this volume—and they include, no doubt, the great majority of mechanical engineers—know that there is no other work like it. Is it not a volume in which we can always find just the information sought? Of how many reference volumes can that be said? The work has gone through several editions. In 1878 he brought out a small volume on "Tramway Construction," subsequently much enlarged and improved, and in 1892 his work on "The Steam Engine and Boilers," which deserves to rank with the very best treatises ever written. This was the last work of any importance Mr. Clark accomplished. During the last few years his health has been gradually failing; of late years he lived a very retired life and was seldom seen in public. He was a member of the Institution of Civil Engineers, joining that body as far back as 1854, and he contributed to it no fewer than eight papers, among which those on the "St. Gothard Tunnel," "Railway Locomotive Stock" and "The Evaporative Performance of Steam Boilers" deserve special mention.—*The Engineer.*

The Most Advantageous Dimensions for Locomotive Exhaust Pipes and Smoke Stacks.*

BY INSPECTOR TROSKE.

(*Continued from page* 31.)

The results obtained from the experiments described in our last issue are shown in the accompanying tables. The highest and lowest value for the vacuum that were observed are not given in the engravings, but an average is taken, as we have already signified, from which there was very little variation. In the diagrams on Plate I., published last month, and Plate II., found in this issue, the space between two adjacent abscissa points denotes a distance in actual practice of 1.57 inches, while the two adjacent points on the axis of ordinates denote a distance of .39 inches.

Experiments were made with two kinds of conical stacks, namely those with and without a reverse inclination. The first are called the waist stacks and the latter the funnel stacks in what follows. In the waist stacks the smallest diameter was located 17.52 inches above the bottom edge, while in the latter this smallest diameter was at the very bottom. All of the stacks had the same heighth of 5 feet 7.68 inches, as shown in Fig. 29 of our last issue. In order to have a definite arrangement for the comparison of the data obtained from the two forms of stack, the waist stack was placed with its smallest section at the same distance from the nozzle opening as was the smallest portion of the funnel stack, whence the nozzle was 17.52 inches above the bottom of the former when it was exactly flush with the bottom of the latter. Hence, upon all of the tables the same figures are given for the same abscissas indicative of the blast-nozzle distances.

The nozzle was held off 1.38 inches from the top of the air chamber of the apparatus. Hence, the shortest distance at which the nozzle could work in all of the experiments was 18.9 inches from the waist of the stack.

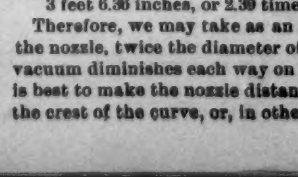
III.—EXPERIMENTS WITH FULL-LENTH STACKS.

CYLINDRICAL STACKS.

In plate I. the vacuum obtained with each of the five experimental stacks, with the five different positions of the blast nozzle, is given graphically. The vacuum obtained with each diameter of blast nozzle, with the five different smokestacks, is also shown. It appears, then, from these groups of curves that, other conditions being the same, the vacuum increases as the stack is made smaller, and the distance to the nozzle increased. Both of these conditions, however, only hold good near the upper limits; for as the curves under (*B*) show, the difference in the vacuum produced by two consecutive stacks becomes less as the stacks are smaller. These variations are also different for different diameters of blast nozzle (the steam pressure remaining the same) and decrease as the distance to the nozzle increases.

TABLE II.
CYLINDRICAL STACKS.

Diameter of stack in inches.		Vacuum in inches of water with a nozzle diameter of				
		3.94 in.	4.33 in.	4.74 in.	5.12 in.	5.51 in.
13.78	Beginning	3.96	4.23	4.53	4.57	4.53
	Crown	4.04	4.29	4.59	4.61	4.53
	End	3.50	3.62	3.76	3.72	3.50
14.76	Beginning	3.70	4.04	4.37	4.45	4.45
	Crown	3.94	4.26	4.57	4.66	4.57
	End	3.54	3.82	4.02	4.06	3.90
15.75	Beginning	3.43	3.76	4.09	4.23	4.29
	Crown	3.74	4.06	4.37	4.51	4.45
	End	3.52	3.82	4.09	4.19	4.08
16.73	Beginning	3.11	3.45	3.78	4.33	4.04
	Crown	3.50	3.84	4.13	4.29	4.33
	End	3.43	3.72	4.02	4.13	4.11
17.72	Beginning	3.80	3.11	3.45	3.62	3.74
	Crown	3.25	3.56	3.90	4.06	4.09
	End	3.25	3.56	3.90	4.06	4.09



NOTE.—The crown or crest of the curve marks the highest vacuum produced.

Referring to Table II, which marks the three characteristic points of each curve, we find that the differences between the values given for the beginning of the curves, for a nozzle diameter of 3.94 inches (starting with the stack of greatest diameter) is 0.31 inch, 0.32 inch, 0.27 inch and 0.26 inch, and where the nozzle diameter is 5.51 inches, these differences are only 0.30 inch, 0.25 inch, 0.16 inch and 0.08 inch. For the first diameter of nozzle, therefore, the limit of diameter for the stack is about 9.84 inches, at which point the vacuum rises to the ratio laid down, the nozzle distance being 18.9 inches, which means that for a diameter smaller than this, the vacuum falls off. For a nozzle diameter of 5.51 inches, the smallest stack has a diameter of about 13.37 inches.

Those stacks giving the greatest indraft of air, as we have shown in the historical portion, have been mistaken by different investigators as being the most efficient, while in reality, they are entirely unsuited to locomotives with nozzles much smaller than those used on the apparatus, on account of the large size of the cinders carried through the tubes and the sparks that are thrown.

If, for a given diameter of nozzle we take the stack diameters as abscissas, and the corresponding vacuums produced as ordinates, we obtain a curve like that shown in Fig. 30, illustrating the rise and fall of the vacuum with the changing diameters of the stacks. We see that, in this case, the graphical representation cannot be taken as the sole indicator of the efficiency of the action of the stack.

The increase in the vacuum, with the increasing distance to the nozzle, naturally becomes greatest with the largest stack. This amounts, for example, to 0.45 inch for an increase of this distance from 18.9 inches to 4 feet 1 inch, and with nozzle diameters equal to 3.94 inches and 4. 74 inches as indicated in Fig. 31, for the smallest diameter of nozzle this gives an increase of 16 per cent. This would have been still greater if experiments had been made with an original distance less than 18.9 inches. This last distance is really too great for a stack 13.78 inches in diameter, as the corresponding curve in Plate II. shows. These diagrams also show that the diameter of the cylindrical stacks must be from 3.7 to 3.8 times the diameter of the nozzle.

Near its highest point the curves are usually nearly straight, and then they begin, on account of the frictional losses, due to the contact of the current of steam against the stack, to take a sharper curvature. corresponding to the fall of the vacuum, and come down toward the axis of abscissas.

If we take for the abscissa of the highest point of the curve, the average values of five different nozzle openings, as given in Table II., the maximum vacuum for the stack is obtained:

With a diameter of 13.78 inches, with a nozzle distance of 1 foot, 10.72 inches, or 1.63 times the stack diameter;
with a diameter of 14.65 inches, with a nozzle distance of 2 feet 4 35 inches, or 1.95 times the stack diameter;
with a diameter of 15.75 inches, with a nozzle distance of 2 feet 9.54 inches, or 2.13 times the stack diameter;
with a diameter of 16.73 inches, with a nozzle distance of 3 feet 0.22 inch or 2.16 times the stack diameter;
with a diameter of 17.72 inches, with a nozzle distance of 3 feet 6.36 inches, or 2.39 times the stack diameter.

Therefore, we may take as an average for the distance of the nozzle, twice the diameter of the stack. But since the vacuum diminishes each way on the curve from the crest, it is best to make the nozzle distance less than the abscissa of the crest of the curve, or, in other words, the nozzle distance should be made less than twice the diameter of the stack. As a practical rule and one which has been successfully applied to different locomotives, we may put the nozzle distance at from 1¼ to 1½ times the stack diameter.

The maximum vacuum is produced if the total height of the stack is made from 4.6 to 4.7 times the stack diameter. This is clearly shown in Table III.

TABLE III.

Diameter of stacks in inches.	The maximum vacuum will be obtained if the distance from the nozzle to the top of the stack is equal to that given in inches below when the nozzle diameter is					The ratio of the total height of the stack to its diameter thus averages
	3.94 in.	4.33 in.	4.74 in.	5.12 in.	5.51 in.	
13.78	5' 5.35"	5' 3.07"	5' 3.00"	5' 2.21"	4' 11.00"	4.5
14.76	5' 10.87"	5' 10.08"	5' 9.29"	5' 8.50"	5' 6.14"	4.6
15.75	6' 2.80"	6' 2.02"	6' 1.23"	6' 0.45"	5' 10.08"	4.6
16.73	6' 6.74"	6' 5.16"	6' 4.48"	6' 3.59"	6' 2.02"	4.6
17.72	6' 9.10"	6' 11.15"	7' 0.25"	6' 10.68"	6' 9.10"	4.7

From the foregoing we come to the following conclusion: *With cylindrical stacks the total distance from the nozzle to the top of the stack should not be more than 4.7 times the diameter of the stack.*

If Nozo and Geoffrey found the greatest draught to be created with a height of stack equal to from six to seven times its diameter, it was certainly due to the small dimensions of their experimental apparatus producing such variations as also caused them to declare that the nozzle should be located close to the lower end of the stack. (At that time it was common practice to place the nozzle flush with the latter.)

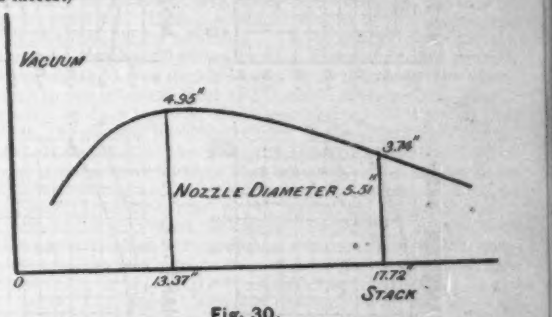


Fig. 30.

From the Hanover experiments, then, and in consequence of the greater distance at which the blast nozzle has been set, we at last come to the determination of the sectional area of the bell-shaped foot of the stack that is commonly used, and the influence, slight as it is, which this actual lessening of the length of the stack may have. This would undoubtedly have been somewhat greater if the cylindrical experimental stacks of from 13.78 inches to 16.73 inches in diameter, but with no flare at the bottom, had had a

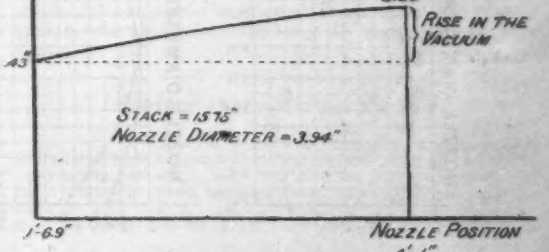


Fig. 31.

base 17.52 inches high, and like Fig. 32, had simply been provided with a smooth funnel-shaped base, as was the case with the stacks of 17.72 inches diameter. According to Section IV., we would have a length for the last-mentioned stack of from 4.8 to 5 times the diameter. But such a length is not susceptible of a practical application, since by the use of such a stack diameter, too high a vacuum and too strong a discharge of sparks would result. For ordinary purposes a length of from 3½ to 4 times the diameter is sufficient,

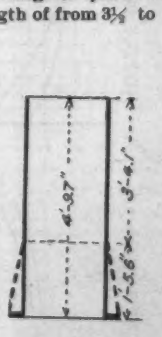


Fig. 32

Fig. 33.

whereby lower results for a large stack diameter (about 17.72 inches) would result. By referring to the average nozzle distances that have been given, the ratios shown in Fig. 33 may be taken as reliable, practical measurements.

(B) CONICAL STACKS.

What has just been said regarding cylindrical stacks can also be accepted as true, in a general way, for conical stacks Except that it appears to be far more sensitive to the nozzle location, since the increase of vacuum with it for the same increase in nozzle location is evidently greater than with the cylindrical stack. This increase for an inch drop in the nozzle becomes more rapid the sharper the flare of the stack

*Paper read before the German Society of Mechanical Engineers.

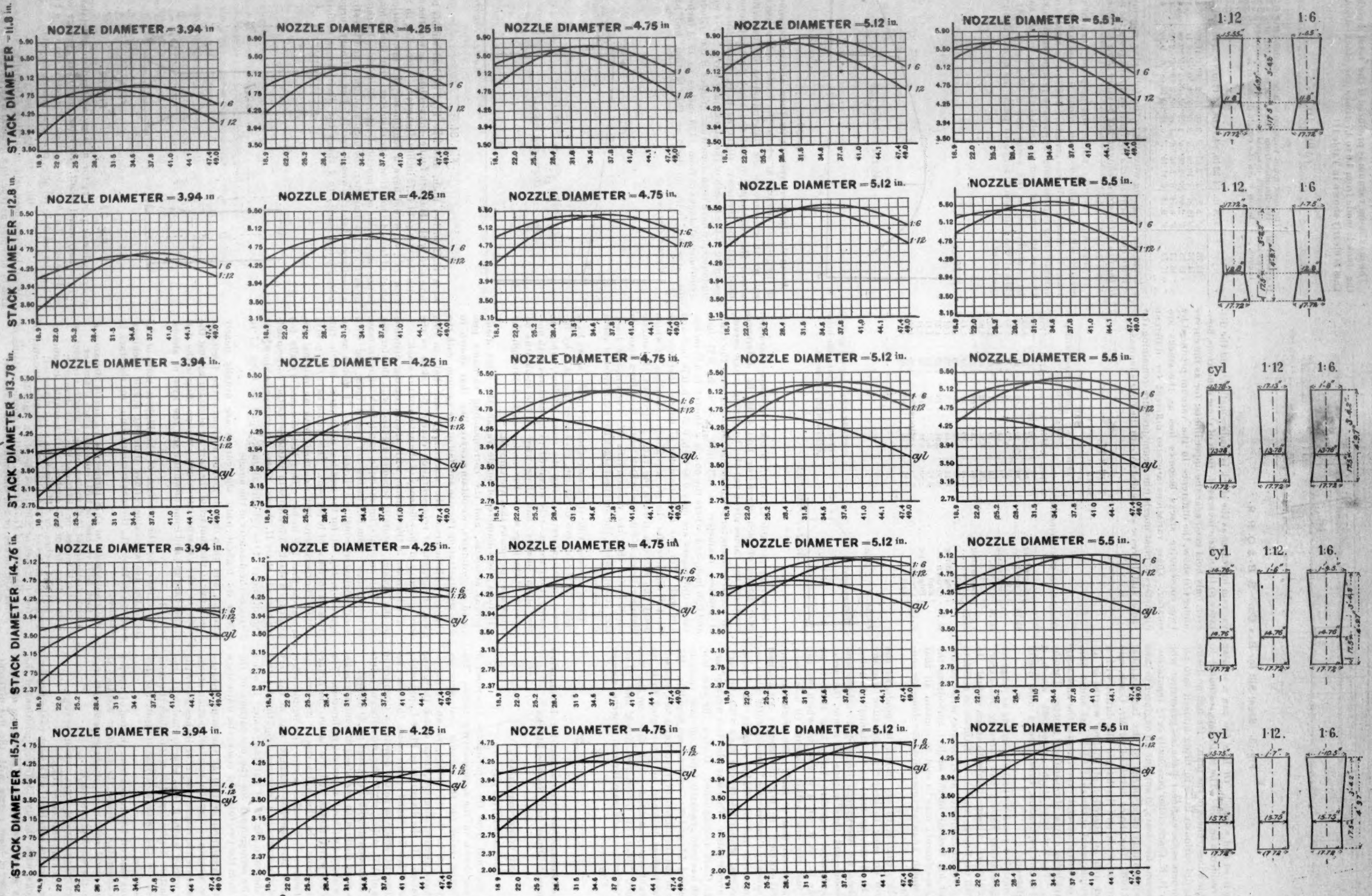


PLATE II.—COMPARISON OF THE ACTION BY CYLINDRICAL AND CONICAL STACKS (HANOVER EXPERIMENTS.)

NOTE 1. The abscissas give the distance of the top of the blast nozzle below the smallest diameter of the stack; the ordinates denote the corresponding vacuum in inches of water.
2. The curves are plotted from an average of the values obtained, and they vary from the maxima and minima observed by from .02 to .08 inch.
3. All of the observations were made with the same steam pressure (3.94 inches of mercury) and with the same opening for the admission of air.
4. The figures at the right hand end of each curve are the diameters of the corresponding blast nozzle or stack.

toward the top (of course within certain limits), as an examination of the curves under II. and III. in Plate I will show, where the curves under II. are very markedly flatter than under III. These results are here tabulated under Tables IV. and V., for convenient reference. Here we take for our example a stack having a maximum diameter of 15.75 inches and a nozzle diameter of 3.94 inches, the vacuum increasing with the increasing distance of the nozzle—for stacks having an inclination of $\frac{1}{12}$, the increase was about 0.96 inches, or 34 per cent., and with one having an inclination of $\frac{1}{8}$ it was 1.61 inch, or about 76 per cent.

TABLE IV.

CONICAL STACKS WITH AN INCLINATION OF $\frac{1}{12}$.

Stack Diameters in inches.		Vacuum in inches of water column with nozzle diameters of				
		3.94 in.	4.33 in.	4.74 in.	5.12 in.	5.51 in.
11.81	Beginning	4.49	4.92	5.35	5.53	5.55
	Crown	5.90	5.29	5.63	5.75	5.67
	End	3.94	4.43	4.65	4.69	4.41
12.80	Beginning	4.08	4.49	4.96	5.15	5.24
	Crown	4.63	5.03	5.41	5.49	5.43
	End	4.13	4.45	4.74	4.78	4.53
13.78	Beginning	3.66	4.06	4.51	4.78	4.90
	Crown	4 37	4 78	5.15	5.28	5.28
	End	4.09	4.45	4.74	4.78	4.71
14 76	Beginning	3.25	3.62	4.06	4.33	4.49
	Crown	4.13	4.49	4.94	5.11	5.12
	End	3.98	4.33	4.69	4.76	4.75
15.75	Beginning	2.82	3.17	3 58	3.86	4.06
	Crown	3.78	4.13	4.55	4.74	4.74
	End	3.78	4.13	4.55	4.69	4.65

TABLE V.

CONICAL STACKS WITH AN INCLINATION OF $\frac{1}{8}$.

Stack diameters in inches.		Vacuum in inches of water column with nozzle diameters of				
		3.94 in.	4.33 in.	4.74 in.	5.12 in.	5.51 in.
11.81	Beginning	3.84	4.31	4.88	5.15	5.32
	Crown	4.98	5.35	5.73	5.87	5 80
	End	4.53	4.93	5.15	5.19	5.02
12.80	Beginning	3.43	3.86	4.37	4.69	4.92
	Crown	4.65	5.06	5.41	5.59	5 59
	End	4.35	4.74	5.06	5.12	5.10
13.78	Beginning	3.02	3.41	3.88	4.21	4 45
	Crown	4.33	4.77	5.15	5.32	5 36
	End	4.21	4.61	4.96	5.06	5.06
14.76	Beginning	2.58	2.95	3.37	3.70	3.96
	Crown	4.12	4.53	4.92	5.10	5 14
	End	4.08	4.47	4.86	4 98	5.02
15 75	Beginning	2.15	2.48	2.85	3.17	3.41
	Crown	3.78	4.15	4.57	4.74	4 80
	End	3.78	4.15	4.57	4.74	4.80

With the same minimum sectional area, and starting with the same nozzle distances, the stack having an inclination of $\frac{1}{12}$ gives a higher vacuum than the stack with an inclination of $\frac{1}{8}$; but the latter creates the same draught if the distance to the nozzle is correspondingly increased. At the same time the two forms of stacks give the same maximum

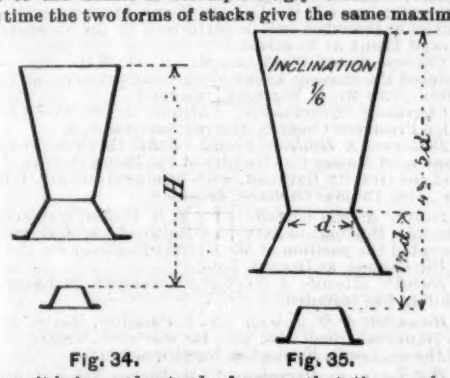


Fig. 34.

Fig. 35.

vacuum, it being understood, of course, that the nozzle distances are different.

Here also the curves run comparatively straight on either side of their crests. Now, if we take, as we have already done for the cylindrical stacks, the average values from Table VI. for the abscissas of the crown of the curves, we will find that the maximum vacuum will be obtained with a stack having an inclination of $\frac{1}{12}$ when its smallest diameter is:

11.81 inches and the nozzle distance is 2 feet 3.95 inches, which is 2.37 times the stack diameter;
12.80 inches and the nozzle distance is 2 feet 7.02 inches, which is 2.42 times the stack diameter;
13.78 inches and the nozzle distance is 2 feet 10.12 inches, which is 2.47 times the stack diameter;
14.76 inches and the nozzle distance is 3 feet 1.48 inches, which is 2.53 times the stack diameter;
15.75 inches and the nozzle distance is 3 feet 4.79 inches, which is 2.59 times the stack diameter.

So that for an average the nozzle distance may be taken to be 2.5 times the stack diameter.

With a stack having an inclination of this maximum vacuum will be obtained when its smallest diameter is:

11.81 inches and the nozzle distance is 2 feet 9.7 inches, which is 2.85 times the stack diameter;
12.80 inches and the nozzle distance is 3 feet 0.62 inches, which is 2.86 times the stack diameter;
13.78 inches and the nozzle distance is 3 feet 3.61 inches, which is 2.87 times the stack diameter;
14.76 inches and the nozzle distance is 3 feet 6.91 inches, which is 2.90 times the stack diameter;
15.75 inches and the nozzle distance is 3 feet 10.22 inches, which is 2.93 times the stake diameter,

So that, for an average, the nozzle distance may be taken at 2.9 times the smallest diameter of the stack.

Now, since the sharp downward inclination of the curves begins at an earlier point on the crown with the conical stacks than it does with the cylindrical, so the maximum results will be obtained with far lower values than is possible with cylindrical stacks. It is, therefore, recommended that, with stacks having an inclination of $\frac{1}{8}$, the nozzle distance should not be more than twice the smallest diameter of the stack. According to observations made upon locomotives the following rule may be considered to prevail: *A nozzle distance from 1¼ to 2 times the stack diameter is an effective one.* This can also be applied to stacks of other inclinations.

The total height *H*, at which the strongest draught is obtained, is shown for both the $\frac{1}{12}$ and $\frac{1}{8}$ inclinations in Table VI. An examination of Table II. shows that the height *H*, Fig. 34, for the conical stack, is greater than that for the cylindrical stack, and that this increases as the opening of the stack at the top is greater.

This ratio relatively to the diameter may be taken to average as follows:

Cylindrical stack..... 4.6
Conical " $\frac{1}{12}$ inclination..... 5.4
" " $\frac{1}{8}$ " 5.8

Again, while this ratio increases with the increase of diameter of the cylindrical stack, it decreases with the conical stack as the inclination is increased.

The maximum heights of vacuum given in Tables III. and VI., taken roughly, are applicable only to stacks whose upper portion above the smallest sectional area is 3 feet, 4 inches long. If we make this latter distance greater, the total stack height falls still more, always, of course within certain limits.

From the applications given above and those given in Sections IV. and V., we can determine the maximum values of the ratios of the total height of the stack to the diameter, which may be stated, in round numbers, to be for:

Cylindrical stacks, about..... 5
Conical stacks with $\frac{1}{12}$ inclination, about..... 6
" " " $\frac{1}{8}$ " " 6½

Furthermore, these are not exact values, since those previously given are too great for actual service and for the same reasons as that assigned for the cylindrical stacks. We, therefore, reach the following conclusion:

When the waist diameter of the conical stack is carefully chosen, the total height should not be more than five times this diameter.

For a perfectly satisfactory construction, the ratios given in Fig. 35 will be found to yield effective dimensions. But when the diameter is 14.17 inches or more, we must use the smaller dimension ($4\frac{1}{2}d$).

(To be Continued.)

The New Baldwin-Westinghouse Electric Locomotives.

The Westinghouse Electric and Manufacturing Company has received the first electric locomotive manufactured under the arrangement entered into some time ago between Westinghousethe Company and the Baldwin Locomotive Works of Philadelphia. It is shown in the accompanying engraving, from which it will be seen to be a radical departure in construction from any electric locomotive hitherto manufactured. It is 38 feet long and 9 feet wide over all. All the operating parts of the locomotive have been placed on the trucks and the body of the car will only contain the controlling apparatus, and can be utilized as a receptacle for such appliances as are usually carried by any train. It may also be used as a freight or baggage car.

Baldwin-Westinghouse Electric Locomotive.

It is carried on four pairs of wheels arranged in two trucks that are constructed in a very substantial manner. The wheels are 42 inches in diameter. There will be four motors of 250 horse-power, each connected to an axle of the locomotive. Thus the entire weight of the locomotive will be available for adhesion. The locomotive completely equipped weighs 160,000 pounds. The motors are geared, which method was decided upon so as to enable the company to use more efficient and durable motors, and also to greatly reduce the cost of the locomotive. It is stated that while the electric locomotive used in the Baltimore tunnel cost about $50,000, the Baldwin-Westinghouse locomotive cost less than one-third of that amount, and yet it will be able to accomplish the same work. Locomotives will be manufactured for tunnel work, suburban traffic and rack locomotives, as well as for elevated railroads. By the time this paper reaches our readers the second locomotive completed by the Baldwin people will be received at the East Pittsburgh factory of the Westinghouse Electric and Manufacturing Company. This last one will be of the elevated railroad type, and is an example of a motor car of the Manhattan Elevated Railroad of New York.

As far as the speed of the new locomotive we illustrate is concerned, it may be stated that the motors have been geared to produce a speed of 75 miles an hour. The locomotive is equipped with air-brakes, which are operated in the usual manner, and are supplied with air by a pump underneath the car driven by an electric motor.

The locomotive has been designed so as to be utilized with any method of electric traction. It can be used with the trolley system, the third rail system, the Westinghouse electro-magnetic system, and can also be utilized in connection with the Tesla polyphase system.

Since it has become known that the Baldwin-Westinghouse companies are constructing electric locomotives, enquiries have come from all over the world for such machines, indicating the wonderful demand there is for such engines when manufactured by well known and reliable firms.

Centrifugal Sand-Mixing Machine.

The firm of William Sellers & Company, Incorporated, Philadelphia, has recently brought out a simple and effective sand-mixing machine, that has resulted in a great saving of labor wherever used, besides more thoroughly mixing the sand for the molder. At a recent meeting of the Foundrymen's Association, Mr. A. E. Outerbridge read a paper on

Fig. 1.—Sand Mixing Machine.

molding sand in which he described the machine, and the following quotations from his paper state the conditions which led up to its introduction:

"Whatever special proportions of sand are used in foundries the same necessity exists in all for thoroughly mixing the old and new materials, and until comparatively recently the old methods of riddling and spading were adhered to. A

TABLE VI.

Diameter of stack in inches.	The highest vacuum is obtained when the total height of the stack measuring from the nozzle to the top of the stack is equal in inches to the figures given below, when the nozzle-diameter is:												The average ratio of the total height of the stack to the diameter of the same.	
	3.94 inches.		4.33 inches.		4.74 inches.		5.12 inches.		5.51 inches.					
	Inclination $\frac{1}{12}$.	Inclination $\frac{1}{8}$.	Inclination $\frac{1}{12}$.	Inclination $\frac{1}{8}$.	Inclination $\frac{1}{12}$.	Inclination $\frac{1}{8}$.	Inclination $\frac{1}{12}$.	Inclination $\frac{1}{8}$.	Inclination $\frac{1}{12}$.	Inclination $\frac{1}{8}$.			Inclination $\frac{1}{12}$.	Inclination $\frac{1}{8}$.
	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.	Ft. In.				
11.81	5 10.08	6 4.48	5 9.69	6 3.59	5 8.50	6 2.02	5 7.72	6 0.45	5 4.57	5 10.87			5.77	6.25
12.80	6 1.23	6 6.34	6 0.84	6 5.95	5 11.66	6 9.10	6 2.41	6 3.59	5 7.72	6 2.80			5.53	6.01
13.78	6 4.48	6 9.50	6 3.59	6 9.1(	6 2.81	6 8.31	6 1.23	6 6.74	5 10.87	6 5.16			5.38	5.78
14.76	6 7.53	7 0.65	6 6.74	7 0.26	6 6.31	6 7.53	6 4.77	6 9.89	6 2.80	6 9.10			5.26	5.62
15.75	6 9.89	7 4.19	6 10.68	7 3.80	6 9.1(	7 2.02	6 8.31	7 1.04	6 6.74	7 0.26			5.14	5.48

few years ago the firm of William Sellers & Company began experimenting upon the preparation of molding and core sand by the aid of centrifugal force. The first machine was a comparatively crude affair, but when the correctness of the principle was demonstrated the apparatus was remodeled and greatly improved. This now thorough, practical and simple machine attracted the attention of visitors at various times and duplicates were made at the solicitation of the representatives of several of the largest establishments in Philadelphia. These little machines then created for themselves a reputation, which was followed by a demand for more of them, and the apparatus illustrated herewith is now regularly manufactured by the Sellers company for sale.

"The machine is remarkable, both as a labor saver and as an improver of molding sand. It accomplishes as much work by the helping of two laborers working three hours a

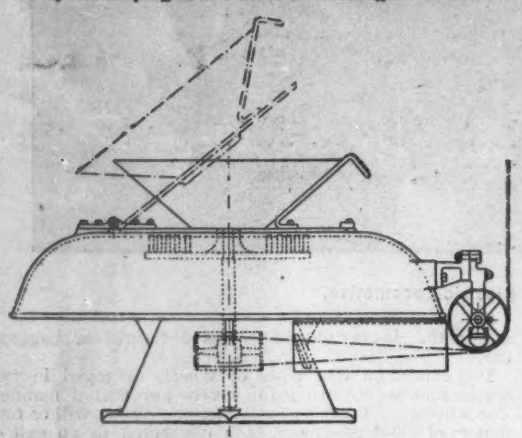


Fig. 2.—Sand Mixing Machine.

day in preparing facing sand as five men could do in 10 hours by the old method, and it is found that as the sand is much more uniformly mixed and tempered, its quality of toughness (without impairment of porosity) is decidedly improved."

The apparatus consists of a rapidly revolving table, having upon its upper surface a number of prongs grouped about a central axis. The sand is fed through a hopper and thrown with great force from prong to prong, emerging from beneath the cover in a fine shower, free from lumps and thoroughly mixed. The hopper is hinged for convenience of cleaning the revolving plate and prongs, and for removing stones, nails, etc. Our illustrations show an exterior view in Fig. 1 and Fig. 2 give the construction. The revolving table is carried on a vertical shaft which may be extended upward and driven from above by a belt, or if more convenient it may be belted from below as in Fig. 2. It is also adapted to be driven by an electric motor. Old sand which has been used in the foundry always contains nails, jaggers, iron scrap, etc., and new sand sometimes contains stones and other foreign substances. Such materials should be removed by the screen before the sand is passed through the machine. Ordinarily good molding sand needs no prior sieving, but is shoveled while damp directly into the hopper. The batches of "facing" and "core" sand are similarly treated. The sand falls upon the rapidly revolving plate, and is thrown with great force from one set of prongs to another, and then emerges from beneath the cover, more thoroughly mixed and better adapted for the molder's use than any amount of hand mixing could have made it.

Mr. J. S. Mundy, of Newark, N. J., the hoisting engine builder, has a contract for the New York Central & Hudson River Railroad for building the new drawbridge engine for the Spuyten Duyvil Creek draw. This drawbridge has a span of 290 feet. The engine has double cylinders with reverse link motion and by means of gearing operates two lines of steel shafts, 4¾ inches in diameter, for opening and closing the draw. The engine is specially arranged for operating their temporary lift draw that is now in use across the Spuyten Duyvil Creek, and as soon as the permanent drawbridge is erected, will be transferred to the new draw. All the material entering into the construction of this engine is of the highest grade and workmanship of the very best.

That the product of the Westinghouse Electric and Manufacturing Company is of world-wide demand has again been demonstrated recently by the company receiving orders to equip an electric railway in the Isle of Man; another order for electric railway apparatus for the city of Coventry, England; and a third order for electric motors and railway generators for Cape Town, South Africa. The company is also about to ship an order for electric railway apparatus to Bangkok, Siam, India. The company is constantly constructing notable machinery for this country also. It recently shipped two of the largest electrical generators for the operation of an electric railway that have ever been turned out anywhere. These two machines are of 1,500 horse power each, and they were contracted for by the Nassau Electric Railway Company, of Brooklyn, N. Y.

The Chicago Tire and Spring Company announces that the business heretofore conducted by that company will hereafter be carried on by the Latrobe Steel Company, which has purchased the former company's plant at Melrose Park, Ill.

Superintendents of motive power and master mechanics will be interested to learn of a compound which is an absolute and permanent rust preventive for all bright parts of locomotives, tools and machinery. Mannocitin, made by Müller & Mann, Berlin, Germany, is such an article, and the fact that it has been adopted by the German Government railways and the leading iron and steel works will go to show that it has a great deal of merit. Mannocitin is composed of greases and volatile oils, leaving a thin, transparent film on the metal, which makes the latter impervious to weather and water and even fumes of muriatic acid and ammonia. The Mannocitin coating is entirely neutral, is not rubbed off in handling but can be quickly removed with turpentine or petroleum.

The same manufacturers also make excellent "rust proof paints," which railways abroad use largely for painting car trucks, roofs and iron structures, and which will interest the master car painter of every railroad.

Mannocitin, as well as Muller & Mann's rust proof paints are being introduced into this country by Otto Goetze 15 Whitehall St., N. Y., who will be pleased to send particulars and free samples to any of our readers on application.

The Abbott Machine Company, of Chicago Heights, Ill., have sold their plant to the Q & C Company, of Chicago, of which W. L. Findlay is President, and Charles F. Quincy, Treasurer. The Abbott company manufacture a check perforator, coin scales and other light machinery. These goods will now be made by the Q & C Company by contract. Additions will be made to the factory, the additions being larger than the old plant, and a foundry will also be built, so as to accommodate the work formerly done at the Q & C Company's shops at 2,634 Shields avenue, Chicago.

The orders for the Leach sanding apparatus for locomotives have amounted to nearly 100 per month for some time past. In January of this year the orders received were for 113 sets, which is the largest month's business thus far experienced with this ingenious device. There are nearly 2,500 locomotives now equipped with them. Those who have given the matter no particular attention should write Mr. H. L. Leach, 176 Huron avenue, North Cambridge, Mass., asking how much saving there is in the use of these sanders.

The Interchangeable Brake Beam Company, of St. Louis, have placed on the market a new metal beam that is to be known as the "Interchangeable." The compression member is of steel in tubular form and the tension member is a round rod. The heads are of malleable iron and are alike for both ends of the beam, there being no rights and lefts. The strut is in two pieces so put together that they are practically one when the truss rod is in place, but by loosening the latter one of the parts can be turned so as to reverse the angle of the slot for the brake lever. A rigid strut is employed if the purchaser prefers it. A recent test of the beam by Professor Johnson, of Washington University, gave the following result:

Diameter of back strut, 2.41 inches.
Diameter of tie rod, 1.00 inch.
Weight of back strut, 20 pounds, 13 ounces.

Applied loads at center. Total pounds.	Deflections at center. Inches.
0	0.0
2,000	0.012
4,100	0.020
6,000	0.039
7,500	0.049
8,009	0.052
10,000	0.069
12,000	0.085
16,000	0.097
18,000	0.017
20,000	0.214
21,720	0.349
27,660	....

The beam broke at 27,600 pounds through failure of the tie rod, which broke in the threads. The strut did not fail. The deflection of the brake beam, as indicated above, was only 0.049 inches for a load of 7,500 pounds, or 20 per cent. less than the allowable deflection, which is $\frac{1}{16}$ inch.

Mr. Clarence S. Bement, of Bement, Miles & Company, Philadelphia, has recently been honored by the Royal Academy of Sciences, at Munich, Germany, which awarded him the silver medal, "Bene Merenti," for his services in the field of mineralogy. Though a busy man, Mr. Bement has found time to bring together a fine collection of minerals, and to do much to advance this science in which he is so greatly interested.

The Chicago Pneumatic Tool Company, 1553 Monadnock Block, Chicago, Ill., received last month another order from London for 10 of their pneumatic hammers, of the size used for flue beading and boiler calking.

Business is good with Messrs. W. A. Crook & Brothers Company, Newark, N. J., the prominent builders of high-grade hoisting machinery, and they have just established a branch office at Boston, Mass., corner of Franklin and Pearl streets, to accommodate the increased business from that section. In addition to their large line of hoisting engines for building, pile driving and general contractors' use, W. A. Crook & Brothers Company build improved hoists for mining and other hoisting purposes, which operate by electricity, and which have become extremely popular.

The Clayton Air Compressor Works, Havemeyer Building, New York, report recent sale of a large duplex steam actuated air compressor of their latest improved pattern to the Pennsylvania Railroad Company for the various applications of this power in their Altoona shops. This company has orders for several large compressors from other railroad companies for their shop uses of compressed air, and are also doing a large business in smaller compressors for testing and inflating hose and bicycle tires and for supplying crude oil burners.

The Standard Boiler Company, of Chicago, report a good business during the past year. They have moved into their new offices, 1120 and 1121 Marquette Building. The "Standard" boilers are built by the well-known firm, The Link-Belt Machinery Company, of Chicago, who have put in new and improved machinery for their manufacture, reducing their first cost as well as making the various parts interchangeable. During the past year a number of fine plants have been installed, among others being 4,000 horse-power for the North Chicago Street Railroad Company, at their new power station at Hawthorn avenue; 500 horse-power for the Cincinnati Edison Company, of Cincinnati, O.; 600 horse-power for the Western Electric Company at their factory in Chicago, and various others. The prospects are good for the year 1896.

Geo. S. Fowler, of Fort Wayne, Ind., who has a large acquaintance among the railroad trade, has accepted a position under the new management of the Kalamazoo Railroad Velocipede and Car Company as their traveling sales agent. This company has been doing business for the last 12 years as a co-partnership, but was incorporated Feb. 5, Mr. G. W. Miller retiring. The new officers are as follows: H. C. Reed, President; E. S. Roos, Vice-President; H. G. Haines, General Manager, Secretary and Treasurer. Mr. Reed, the new President, is a capitalist having large interests in various manufacturing enterprises in Kalamazoo. The new management proposes to enlarge and increase its facilities for manufacturing, and to furnish goods of unexcelled quality in its line so as to merit increased confidence and continued orders. The company shipped last month one each of their No. 9 "Special" steam inspection cars and 2 horse-power gasolene motor cars to Australia. They also shipped recently one 8 horse-power gasolene motor car to Mississippi, and one No. 9 "Special" steam inspection car to Buenos Ayres, South America.

From New York to Florida.

FLORIDA can be reached by the New York & Florida Short Line Limited. A train of Pullman's most modern build, elegantly appointed, and has all requirements of first-class travel, a compartment, observation, library, dining and sleeping car, and is operated solid between New York and St. Augustine, carrying Pullman drawing-room sleeping cars from New York to Augusta and Tampa. Asheville, Nature's Sanitarium, located in the mountains of western North Carolina, is reached in twenty-two hours from New York, via the Southern Railway, in Pullman drawing-room sleeping cars.

Our Directory

OF OFFICIAL CHANGES IN FEBRUARY.

We note the following changes of officers since our last issue. Information relative to such changes is solicited.

Atchison, Topeka & Santa Fe.—Mr. J. Foster has been appointed Master Mechanic at La Junta, Colo., vice Mr. I. Conroe.

Baltimore & Ohio.—John K. Cowen has been chosen President to succeed Mr. C. F. Meyer; Mr. Oscar G. Murray appointed First Vice-President, to succeed Mr. Orlando Smith, resigned. Second Vice-President T. M. King has resigned.

Baltimore & Ohio Southwestern.—Mr. T. M. King has been elected President.

Beech Creek.—George Thompson has been appointed Master Mechanic, with headquarters at Jersey Shore, Pa.

Boston & Albany.—Mr. F. D. Adams has resigned the position of Master Car Builder.

Buffalo & Susquehanna.—Master Mechanic J. D. Campbell has resigned, to take effect when his successor has been appointed.

Canadian Pacific.—Mr. R. Atkinson, who has been Acting Mechanical Superintendent, has been given the title of Mechanical Superintendent.

Central of Georgia.—Mr. H. M. Comer has been elected President of the road.

Chester & Lenoir.—Mr. G. W. F. Harper, President, has been appointed Receiver.

Chicago & Grand Trunk.—C. M. Hays, by virtue of his appointment as General Manager of the Grand Trunk, becomes President of the Chicago & Grand Trunk. Mr. W. J. Spicer, General Manager of this and other Grand Trunk properties west of the Detroit River, has resigned, and the duties of the office will be performed by the Manager of the Grand Trunk at Montreal.

Chicago Great Western.—Mr. A. D. Ward has been appointed Purchasing Agent, with headquarters at St. Paul, Minn., vice Mr. J. Warwick, resigned.

Cleveland, Cincinnati, Chicago & St. Louis—Second Vice President Oscar G. Murray has resigned.

Delaware & Hudson Canal.—John H. Orchard has been appointed Master Car Builder of the Pennsylvania Division and the Gravity Railroad, with headquarters at Carbondale, Pa., vice Thomas Orchard, deceased.

Denver & Rio Grande.—Mr. T. R. Foster, formerly on the Chicago, Burlington & Quincy Railroad, at Galesburg, has accepted the position of Mechanical Engineer on the Denver & Rio Grande, at Denver, Colo.

Duluth, Missabe & Northern.—General Manager D. M. Philbin has resigned.

Hannibal & St. Joseph—N. J. Paradise, Master Mechanic at Hannibal, died Jan. 27. He was also Master Mechanic of the St. Louis, Keokuk & Northwestern.

Hot Springs.—President E. M. Dickey has resigned.

Houston, East & West Texas.—President E. S. Jamison died last month.

Kansas City, Pittsburg & Gulf.—Mr. T. C. Sherwood has been appointed General Manager, with office at Kansas City, Mo.

Michoacan & Pacific.—The office of general manager has been abolished.

New York Central & Hudson River.—Mr. E. C. Hiser, Master Mechanic at Utica, has resigned.

New York, Lake Erie & Western.—Mr. George Donahue, formerly Master Mechanic at Cleveland, has been transferred to Meadville, Pa. Mr. Willard Kells has been made Master Mechanic at Cleveland, O.

Ohio River.—The office of President is made vacant by the decease of Col. W. P. Thompson.

Oregon Railway & Navigation Company.—Mr. F. G. Wheeler is Purchasing Agent, with office at Portland, Ore.

Philadelphia, Reading & New England.—Mr. W. J. Martin has been appointed General Manager, vice Mr. C. M. Lawler, resigned.

Pike's Peak.—C. W. Sells has been appointed Manager.

Plant System.—Mr. W. J. McLean has been appointed Master Mechanic of the Third Division, with headquarters at Montgomery, Ala.

San Antonio & Gulf Shore.—Mr. Wm. Davis has resigned the position of President.

Seaboard Air Line.—Mr. John H. Winder has resigned the position of General Manager and the duties of the office will hereafter be performed by the Vice-President.

Southern.—Mr. W. H. Thomas has been appointed Superintendent of Motive Power, vice Mr. R. D. Wade, resigned. Mr. C. H. Hudson, Chief Engineer, has been made Mechanical Engineer also, with advisory duties in connection with the mechanical department. Mr. W. H. Young has been made Master Mechanic of the Charlotte Harbor division, with headquarters at Sanford, Fla.

South Haven & Eastern Railway.—Mr. M. V. Meridith was appointed General Manager, Feb 1.

Wheeling & Lake Erie.—General Manager Albert G. Blair has also been chosen President. Mr. W. R. Setchell has been appointed Master Mechanic at Norwalk, O., vice Mr. O. P. Dunbar.

Employment.

A young progressive Master Car Builder with large experience in designing and building cars is open for an engagement as Master Car Builder or assistant to same, either in railroad shops or private car line. Address "NEW CARS," care of AMERICAN ENGINEER, CAR BUILDER AND RAILROAD JOURNAL.